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computing today

FEBRUARY 1982

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

All material should be typed. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Acting Editor at our Charing Cross Road address.

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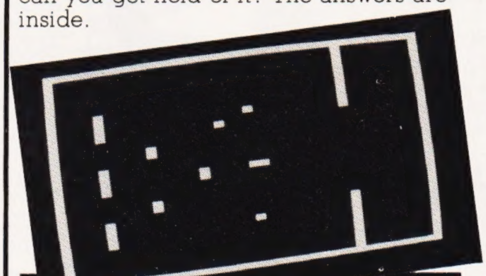

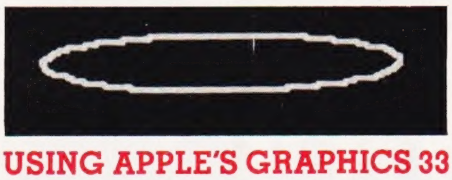

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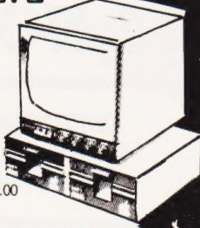

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APPLE II (48K) COMPUTER	£695.00
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All items are available through our fast, efficient mail order service. If you find our prices are not competitive, then we will be pleased to match any genuine offer in this magazine.

P & P Rates: a 0.75 b 1.00 c 1.50 d 2.50

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EXPANSION UNIT WITH 16K RAM	**£215.00**
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(Please add VAT to prices above)

Superior Systems Ltd.

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MONEY SAVERS

with the exclusive MicroValue 12 Months Warranty*

MicroValue Exclusive

MV1 - a Z80 computer

SAVE £107.50

The MV1 computer kit uses the ubiquitous Nascom 1 Pcb and the Z80 CPU. Interfaces are included for television, printer and cassette. 2K memory, Gemini power supply (drives up to 3 extra boards). Cherry full ASCII keyboard and Quantum Graphics are also included. Available with either an ASCII version of the Nas-Sys 3 monitor, or a Tiny BASIC. MV1 is expandable to Gemini 80-BUS specification.

MicroValue price
£105 + VAT

MicroValue Exclusive

MicroValue's 'Nascom Special'

SAVE OVER £65

We've put together a microcomputer kit containing the Nascom 2, Nas-Sys 3, Graphics ROM, Bits & P.C.'s programmers aid, Gemini 3 APSU, 16K RAM Board and mini motherboard. The result is a powerful micro using market proven boards and components.

RRP OVER £405 + VAT
£340 + VAT

MicroValue Exclusive

SHARP MZ80K with Super Graphics

SAVE £200!

The 48K RAM System is offered at a rock bottom price with the Quantum Micros Hi Res Graphics which gives resolution down to a single dot and high res. plotting. Characters are user definable and the pixel characters actually *join*. Five free games packages are included too!

RRP £645 + VAT
MicroValue price
£445 + VAT

SHARP

£30 worth of accessories FREE with every Epson Printer

	MicroValue price
Epson MX80T	£359 + VAT
Epson MX80FT1	£399 + VAT
Epson MX80FT2	£465 + VAT
Epson MX100	£575 + VAT

Buy one of the above Epsons from MicroValue and we'll give you a Pack of Fanfold paper, Spare Ribbon Cartridge, Interfacing Document and Connecting Cord for Multiboard or Nascom. The accessories are worth £30 but you can have them absolutely FREE.

Cheapest Printer in the UK!

Nascom IMP + Graphics Only £199 + VAT

SAVE £156

MicroValue has slashed the price of the 80cps, 80 column IMP dot matrix printer. And added Imprint's high res. graphics and double width character option. IMP has bi-directional printing and friction/tractor feed.

RRP £355 + VAT
MicroValue price
£199 + VAT

NASBUS Compatible DOUBLE DENSITY Disk System - Available Ex Stock

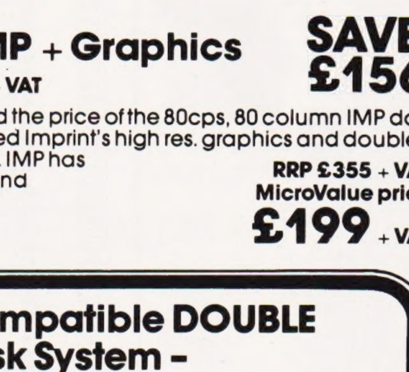
With hundreds in daily use the Gemini Disk system is now the standard for Nascom and Gemini Multiboard systems. Single or twin drive configurations are available, giving 350K storage per drive. The CP/M 2.2 package supplied supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers, and auto single-double density selection. An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 2 it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single drive system (G809, G815/1)
£465 + VAT

Double drive system (G809, G815/2)
£690 + VAT

CP/M 2.2 package (G513)
£100 + VAT

Polydos 2
£90 + VAT



MicroValue

MONEY SAVERS

with the exclusive MicroValue 12 Months Warranty*

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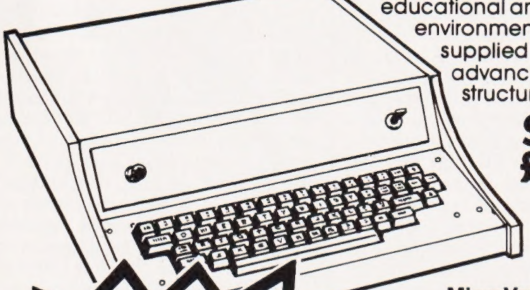
MV2-Twin Z80A Controlled Development Computer

The fully built and tested MV2 microcomputer is controlled by two Z80A microprocessors. Interfaces include RS232, cassette, 2 × 8 bit parallel ports, and graphics including programmable graphics. It provides 80 × 25 screen format and includes 64K RAM, Integral PSU and full ASCII keyboard.

Software written to run under the RP/M ROM based monitor can be transferred to disk to run under CP/M at a later date. This rugged computer is ideal for educational and industrial environments and is supplied with the advanced COMAL structured BASIC.



SAVE £76.50

MicroValue price **£595** + VAT

MicroValue Exclusive

80 × 25 Video for Nascom

Nascom owners can now have a professional 80 × 25 Video display by using the Gemini G812 Intelligent Video Card with onboard Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Built and tested.

£140 + VAT

MicroValue Exclusive

NEW

I/O Board for Nascom & Gemini Multiboard Systems

Quantum I/O

The new Quantum Micros I/O board takes the unique approach to the problems of interfacing your Nascom or Gemini Multiboard to external devices. This 80 Bus and Nasbus compatible card is supplied fully built, populated and tested and includes three Z80 PIOs, a CTC and a Real Time Clock with battery back-up. In addition, a range of "daughter" boards that attach straight to the I/O board are under development catering for a wide variety of interfacing requirements.

Quantum I/O board MicroValue price – **£140** + VAT

Prototyping daughter board MicroValue price – **£20** + VAT

IEEE-488

The EV Computers' IEEE-488 card is an 80 Bus and Nasbus compatible card designed to fully implement all IEEE-488 interface functions. This built and tested card gives the user a very cost effective and versatile method of controlling any equipment fitted with a standard IEEE-488 or GPIB interface.

MicroValue introductory price

£140 + VAT

MicroValue Exclusive

New Software for Nascom Systems

POLYDOS 1 A disk operating system for use with Nascom 1 or 2 and Gemini G805 Disk Systems. An incomparable and extremely well presented DOS that includes an editor and assembler and adds disk commands to the Nascom BASIC. MicroValue price **£90** + **VAT**

MATHSPAK Double precision maths package on tape. MicroValue price – **£13** + **VAT**

MATHSPAK Handler Used in conjunction with MATHSPAK. MicroValue price – **£9.95** + **VAT**

Command Extender For use with MATHSPAK it extends BASIC's reserve word list. MicroValue price – **£9.95** + **VAT**

Logic Soft Relocater An integrated assembler and disassembler package which allows disassembly and reassembly from anywhere on the memory map. MicroValue price – **£13** + **VAT**

SAVE MORE MONEY

Standard Firmware for Nascom at Reduced prices

NASPEN	RRP £30 + VAT	**MicroValue price £20 + VAT**
Nas-Sys 3	RRP £25 + VAT	**MicroValue price £20 + VAT**
NasDis + D-Bug (EPROM)	RRP £50 + VAT	**MicroValue price £30 + VAT**
NasDis + D-Bug (TAPE)	RRP £40 + VAT	**MicroValue price £20 + VAT**
imprint	RRP £30 + VAT	**MicroValue price £20 + VAT**
Bits & PCs Prog. Aid	£28 + VAT	**MicroValue price £20 + VAT**

*MicroValue Warranty

All products, except kits, sold by MicroValue dealers are supplied with 12 months' warranty and will be replaced or repaired by any dealer (even if you didn't buy it from him) in the group in the event of faulty manufacture.

YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right. (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.

BITS & PC'S
4 Westgate, Wetherby, W.Yorks.
Tel:(0937) 63774.

ELECTROVALUE LTD.
700 Burnage Lane, Burnage, Manchester M19 1NA.
Tel:(061) 431 4866.

28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel:(0784) 33603. Tlx:264475.

SKYTRONICS,
2 North Road, The Park, Nottingham.
Tel: (0602) 45053/45215

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel:(0272) 421196.

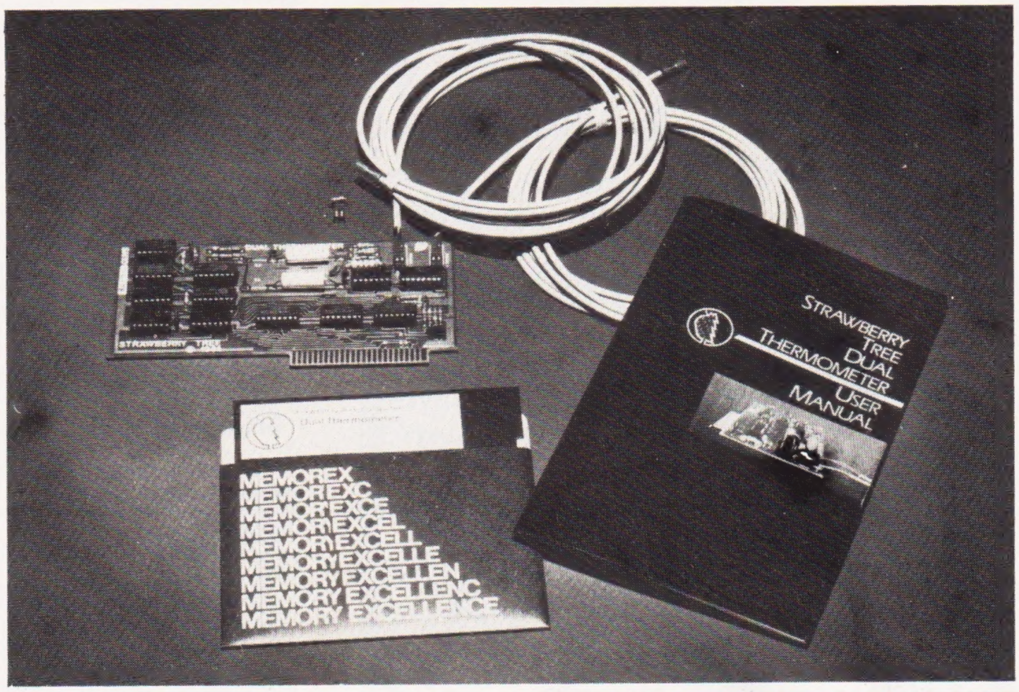
INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel:(02403) 22307. Tlx:837788.

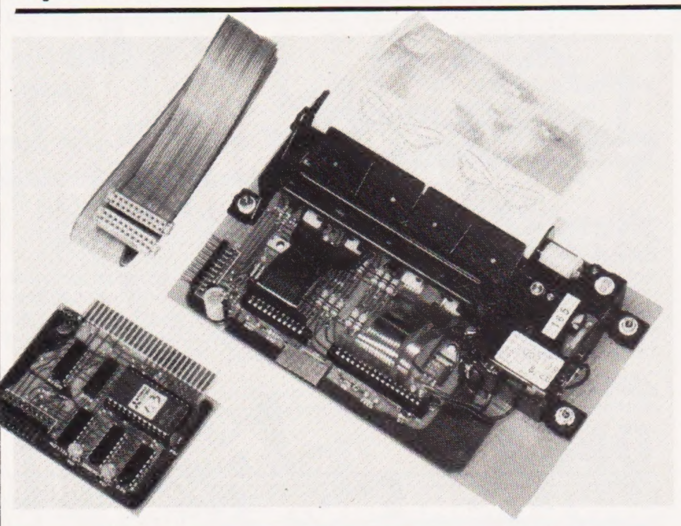
HENRY'S RADIO
404 Edgware Road, London W2.
Tel:(01) 402 6822.
Tlx:262284 (quote ref:1400).

LEEDS COMPUTER CENTRE,
62 The Balcony, Merrion Centre, Leeds.
Tel: (0532) 458877

FEEL THE HEAT ▶

If you've ever felt the need to take your Apple's temperature then this dual thermometer card from the States might be useful. It might also be just the thing you've been looking for if you use the system for datalogging, temperature monitoring or control. The two probes are fitted with 10-foot leads to ensure that the computer is located well away from the source of the heat and they operate between – 55 and + 125 degrees centigrade. The probes can be extended to 500 feet without loss of accuracy. Hardware requirements are a 48K Apple with Applesoft in ROM and a disc. The cost is $240 and you can order direct using your Access or Barclaycard (they call them Mastercharge and Visa out there). For a brochure contact the manufacturers, Strawberry Tree Computers, at 949 Cascade Drive, Sunnyvale CA 94087. You can ring on (408) 736-3083. Please tell them where you saw the item as it helps all of us.





◀OUT OF ITS BOX

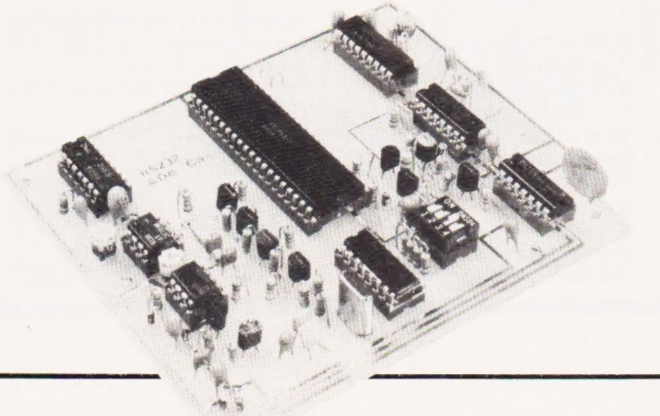
The RX40 Apple 40 column printer, recently introduced by Roxburgh Printers, makes it possible to reproduce most of the graphics facilities available on the Apple as hard copy, including 'screen dump' and high resolution graphics. Consisting of a 40 column PU1840/ 2P thermal mechanism mounted on its own driver card, it is connected via a special interface directly into one of the available slots inside the Apple. The complete package is priced at £152.00. Further details are obtainable from Keith Evans at Roxburgh Printers Ltd, 22, Winchelsea Road, Rye, East Sussex TN31 7BR or telephone him on 07973-3777.

DE-BUG DE ZX81

For those of you, frustrated in your attempts to program the ZX81 at machine code level, here is a fast, versatile machine code de-bug program, designated ZX-MC. Perhaps the most useful feature of this device is its ability to save a named file to a cassette from any area of RAM and then load that named file back into the correct area of RAM, all at double speed, allowing the user freedom from the restrictions of the BASIC operating system. Available on cassette priced at £6.50, the ZX-MC package comes complete with full documentation. For information on the additional features of the ZX-MC, contact Picturesque, 6, Corkscrew Hill, West Wickham, Kent BR4 9BB or ring them on 01-777 0372.

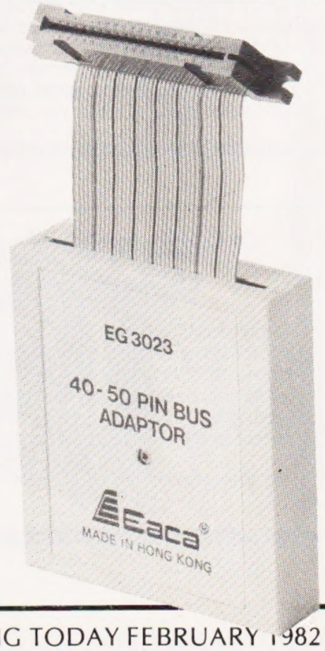
UNIVERSAL CONVERSION

Any computer equipped with a serial I/O can interface to the 'analogue' world and vice versa using the newly-designed RS232 ADA system from Whitemice Software. Utilizing a fast sample-and-hold, true eight-bit conversion of either DC or AC input signal is obtained in the range 0-2V5, conversion initiated by either a computer or from a remote source. This product is available in kit form for a mere £39.50 or £49.50 built. For any additional information get in touch with Ambit International, 200, North Service Road, Brentwood, Essex CM14 4SG.



A WISH COME TRUE ▶

Hot on the heels of the Genie 2 comes the EG3014, introduced to expand the facilities on the Genie 1 and 2 systems. Priced at under £200, the EG3014 has some useful features including full disc control facility for up to four drives at single or double density, a Centronics parallel printer output, a plug-in S100 bus option, and a 16K expansion memory as standard, expandable, if necessary, to 32K. And if that sounds good to Genie users, an adaptor, EG3023, allows the EG3014 to be connected to the Tandy TRS-80 system. For information on either the EG3014 or EG3023 contact Robert Stead at Lowe Electronics, Bentley Bridge, Chesterfield Road, Matlock, Derbyshire DE4 5LE or phone him on 0629-4995.



CONSUMER NEWS

FELIX THE CAT ▶

CAT, as in Computer-Aided Training and FELIX, as in a system that combines video and computer techniques to provide an effective interactive teaching aid. Comprising a television screen and a video cassette recorder, the FELIX system employs at its heart a DAI microcomputer controlling the training presentation, answering student enquiries and providing students with immediate feedback on their performance. The complete system cost, excluding disc storage and printer, will be £3850. Further information can be provided by Ian Phillips of Felix Learning Systems Ltd, 25-27, Farringdon Road, London EC1 or ring him on 01-404 5041.

◀ THE MICRO CHAIN

Laskys, Europe's largest specialist hi-fi chain, having acquired Microdigital Ltd (Bruce Everiss's independent microcomputer store) have wasted no time establishing microcomputer departments in ten of their major stores around the country including Liverpool, Manchester, Birmingham, Edinburgh and most recently, London. Customers in Nottingham and Kingston, never fear, the banner 'Microcomputers at Laskys' is soon to be hoisted in your areas early in 1982. For news of other scheduled openings write to Laskys, Hardman House, The Hyde, London NW9 6JJ or call on 01-200 0444.

MEDIA MANIA

Both Willis Computer Supplies and Inmac have released their latest catalogues for the DP manager and programming departments. Both are packed with new offerings intended to make the computer user's life a happier one and both are free. Write to Willis Computer Supplies at PO Box 10, South Mill Road, Bishop's Stortford, Herts CM23 3DN or Inmac UK Ltd, at 18 Goddard Road, Astmoor Industrial Estate, Runcorn, Cheshire WA7 1QF.

ADAPTING TO THE BUS

Icarus Computer Systems are offering an S100 bus adaptor for the SuperBrain computer at £255. The board can be fitted internally allowing one S100 card to be controlled or mounted externally in an S100 frame allowing for expansion. As mentioned elsewhere in this issue Interec have been offering this facility for a while but it has never appeared on the UK market — it seems to have needed a UK company to produce it. For further information contact Icarus at Deane House, 27 Greenwood Place, London NW5 INN or ring on 01-485 5574.

BUG BYTES

As regular readers are probably aware, we are slowly changing the way we print listings. If proof were required that the old system failed occasionally, you need look no further than the program entitled NASCOM Memory Display on page 21 of that issue. Yes, you've guessed, it has one or two small bugs in it! The following lines should be changed to get any sense out of the program at all:

```
170 FOR X=U TO G:P=P/T
310 SCREEN 30,9:PRINT
    "[3 SPC]"
490 T$="[SPC]NASCOM
    MEMORY DISPLAY[SPC]"
510 POKE W+X,ASC(MID$(T$,
    X,1))
680 SCREEN 4,7:PRINT"Memory
    [11 SPC]Binary"
750 DATA 8,12,13,20,21,22,24,27
```

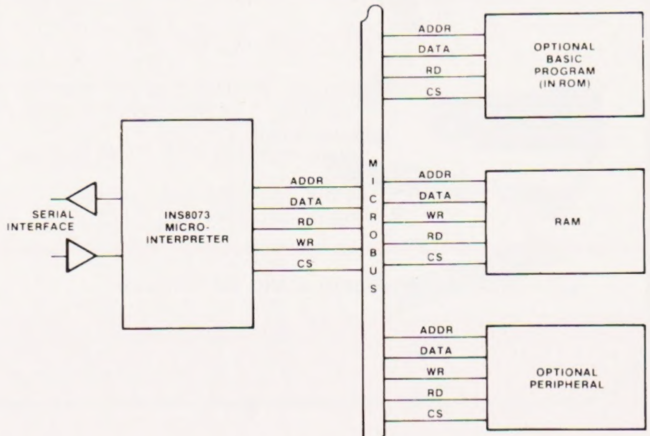
Our thanks to the author who managed to report the faults before anyone else spotted them. Sackcloth and ashes are now the prescribed uniform!

MORE ON A MICRO

Combining a central processor unit and a Tiny BASIC interpreter on a single chip, the National Semiconductor INS 8073 allows users to write and debug programs online. The device, as we mentioned last month, can perform control and computation functions, executing source code directly avoiding the bother of translation into machine language. The manufacturers also claim reductions in software effort in microcomputer system development, simplified source code manipulation and instant program revision, ease of program and hardware checkout and finally, the facility to produce fast sketches of control algorithms. The price of the device varies depending on the quantity you order, 1-24 units will cost £30.63 each, 25-99 units will cost £24.51 each and 100 up will cost you £20.43 each. Additional information can be obtained from Dave Greenfield at Hi-Tek Distribution Ltd, Trafalgar Way, Bar Hill, Cambridge CB3 8SQ or telephone him on 0954-81931. ▶

FREE CATALOGUE

Bernard Babani (Publishing) Ltd have just announced their new 1982 catalogue of radio, electronic and computer books. To obtain a free copy of this extensive booklist, simply send your name and address to the company at The Grampians, Shepherds Bush Rd, London W6 7NF.



WHAT'S IN A NAME ▲

The British-designed Gemini System 801 has now been renamed the British Micro MIMI 801. Essentially similar in format, the MIMI 801 exhibits a few small improvements over the Gemini, the most noteworthy being a built-in custom Cherry keyboard having 96 keys including a numeric keypad and 14 special function keys. As standard the MIMI 801 incorporates 64K of RAM as well as 700K of online storage from twin double density, double sided Pertec floppy disc drives. Expansion of this storage can be achieved using five and 10M 5¼" Winchester drives to replace one of the floppy drives. All enquiries should be directed to Manas Heghoyan, British Micro, Penfold Works, Imperial Way, Watford, Herts WD2 477 or telephone 0923-48222.

SUPER GRAPHICS

Designed to compliment the SuperBrain computer, the new SuperVid device is able to offer both ASCII and block graphics ROMs, the latter providing continuity of display across adjacent blocks and giving a resolution on the screen of 160 x 72 points. Screen text can be either highlighted or displayed in 'background', underlined or updated, or made to pulsate in a specified area. If required, these various modes can be mixed on screen. Complete with manual and instruction diskette, SuperVid is priced at £190. Further details may be obtained from MicroMods Ltd of 53, Acton Road, Long Eaton, Nottingham NG10 1FR or by telephone on 06076-64264.

DOG STARS ON▲ STAGE?

Entering the market, stage right, is the new ACT Sirius 1 a personal computer based on Intel's 8088 microprocessor. Programmable in configuration, the device includes a standard semiconductor memory of 128K, expandable to 512K. Also integrated into the system are two single-sided floppy discs capable of handling 1.2M of memory storage. Utilising CP/M-86 or MSDOS software operating systems with Microsoft BASIC-80 supplied as standard, Sirius 1 also offers optional languages such as COBOL, Pascal and FORTRAN. Other features include two serial ports, a parallel port and a disc expansion potential of up to 10M by replacing one of the floppy discs with a Winchester drive unit. Introduced at the system price of £2395, it's no wonder that the ACT Sirius 1 is being tipped as a 'serious competitor to the Apple 3 and IBM Micro systems'. For further details get in touch with ACT (Microsystems) Ltd at Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT or telephone 021-501 2284.

PRESTEL PLUS ▼

The Viewdata II desktop system has been designed to raise the potential of the Prestel terminal to that of an office computer, complete with facilities for automatic dial-up and storage, high definition colour graphics, analysis and word processing. Comprised of a dedicated computer with two disc drives, a high grade colour monitor and a full editing keyboard, this basic system can be extended with remote terminals and display screens. A useful package for the business person, the basic Viewdata II system will retail at £3674. For further details contact Hi Tech Electronics, 54, High Road, Swaythling, Southampton SO2 2JF or call them on 0703-581555.

THE HARD/SOFT OPTION

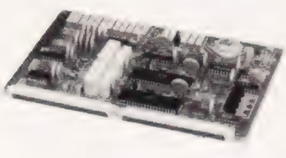
Keen Computers have now developed the necessary interfaces allowing the Commodore PET to operate in a full microcomputer networking environment with up to 64 stations sharing the same central Corvus hard-disc of five, 10 and 20M. This offers advantages to users such as immediate access to mass storage media without interference from other users and data transfer at 60 thousand bits per second — benefits usually associated with mainframe networks. The interface devices available for the PET/Corvus installations are the Hardbox and the Softbox. The Hardbox allows the continued use of PET DOS version 2, control of up to four Corvus hard discs and the operation of up to 64 PETs in a multi-user configuration. The Softbox allows the PET/Corvus network to operate under the CP/M operating system, again providing full Corvus facilities. The Hardbox is priced at £495 and the Softbox is £615. Full details may be obtained from Keen Computers Ltd, 5, Giltspur Street, London EC1 or by telephoning 01-236 5682.▼

SEVEN-UP ▶

The M-Three personal computer, originally introduced to the market last summer, is now available in seven different versions — all incorporating a CP/M operating system. Storage is provided by a single sided, double density mini floppy giving 350K in the smallest model and five and 10M Winchester discs in the largest model available. All models have 64K of dynamic RAM, a Z80 processor, 2K of 'bootstrap' loader PROM and 2K of monitor de-bug diagnostic PROM. Recommended end user prices begin at just over £2000 and rise to £5800 for the larger model. All enquiries should be directed to LSI Computers Ltd, Copse Road, St John, Woking, Surrey GU21 1SX or by telephone on 04862-23411.

TWO FOR INDUSTRY

Two new individual microcomputer interfaces, a 12-bit A/D converter and a 24-channel multiplexer, have been added to the Machsize range. Both devices are installed on 8¼" x 5" printed circuit cards, are equipped with the IEEE-488 bus and have 64-way indirect, two-part connectors for input, output and input-output signals. Both circuits are supplied complete with detailed documentation as well as tape and disc software. The price of the 12-bit A/D converter is £225, the 24-channel multiplexer is £195. More detailed data can be obtained from Duncan Smyth, Machsize Ltd, York House, Clarendon Avenue, Leamington Spa, Warwickshire CV32 5PP or by telephone on 0926-312542. ▼



TALKING HEADS

From Greek mythology to modern technology comes the Hydra system, capable of linking up to 255 PETs together thus enabling them to talk to each other, load or save programs and interchange screen displays. Comprising a simple plug-in board, it is easily installed and compatible with the 3000, 4000 and 8000 machines. Hydra will cost £125 for each PET in your system, the price being inclusive of hardware, software and accompanying manual. For further information contact Wordcraft Systems, 9, Littleover Lane, Derby DE3 6JF or telephone on 0332-760127.

BEST OF THE WEST

Direct from the States, the Sundance is being offered as the 'ultimate in desktop business computers'. The system features an internal 6M Winchester disc memory backed by an integral 12M cartridge tape facility. Available with a full range of software including comprehensive accounting and business planning capabilities, the Sundance also includes a powerful word processing system. Sundance can be simply upgraded to a full multi-user system, providing high speed local-area network communications with compatible systems up to 2000 feet away. Supporting either the CP/M or OASIS operating systems, the basic Sundance system starts at less than £5500. For additional information contact Keen Computers, 5, Giltspur Street, London EC1 or by telephone on 01-236 5682. ▼

DE-CIFER THE PROBLEM

Incorporating an integral screen and a detachable keyboard, the new Series 1 range of desk top computers from Cifer offer a wide choice of built-in disc storage options using combinations of floppy and Winchester discs. Expected to be the most popular of the range are the 1887 offering 12M of storage from a Winchester disc and 800K from a floppy disc, and the 1888 with 2.4M from three floppy discs. External add-on disc storage facilities can extend the total Series 1 capacity to four Winchester drives providing 48M and four floppy discs giving a further 3.2M. The price of the range starts at £2700 for the 1886 with two built-in floppy discs; rising to about £5000 for the 1887 incorporating one Winchester and one floppy disc with 250K of RAM and an IEEE-488 interface. Additional information is available from Stuart Gregory of Cifer Systems Ltd, Avro Way, Bowerhill, Melksham, Wiltshire SN12 6TP or 'phone him on 0225-706361.

Raising their business sights, Sun Computer Services Ltd have moved to larger premises in Feltham. Their new address is Concorde House, St Anthony's Way, Feltham, Middlesex TW14 0NH and the new telephone number is 01-890 1440.

THREE PET TITLES from Nick Hampshire

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"... well prepared, fun to use, and will help in better program development."
Compute

THE PET REVEALED

A reference book which details everything you need to know about the workings of the PET. Containing information helpful to writing more elaborate programmes, which in turn create more interesting functions.

"... Should be congratulated. Supplies some much needed, useful and correct documentation."
Compute

"... 'PET Revealed' will save you an awful lot of time. I rate this book as good value for money."
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PET GRAPHICS

This book has two objectives. One, to provide the reader with an introduction to the programming techniques used to generate graphic displays. Two, providing the programmer with a complete package of machine code routines giving a wide range of normally unavailable graphic functions. The book contains many comprehensively analysed routines and photographs to illustrate the effects created.

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J R Parkes

A giant 'Detail' for UK101 and Superboard II owners revealing their system's subtleties.

Among the more popular single board machines equipped with graphics are the Superboard II and its UK competitor, the UK101. The two systems are basically very similar but they do have differences both in their graphics sets and the layout of the screen memory.

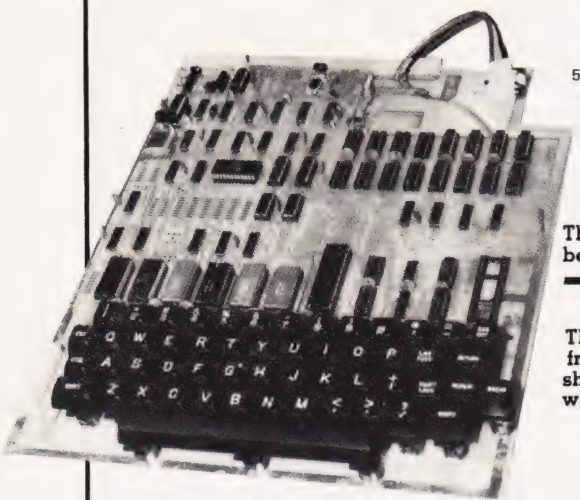
This slightly larger than usual Graphic Detail is intended to reveal these differences and make program conversion between them simpler. It should also be of use to those converting to or from totally different systems.

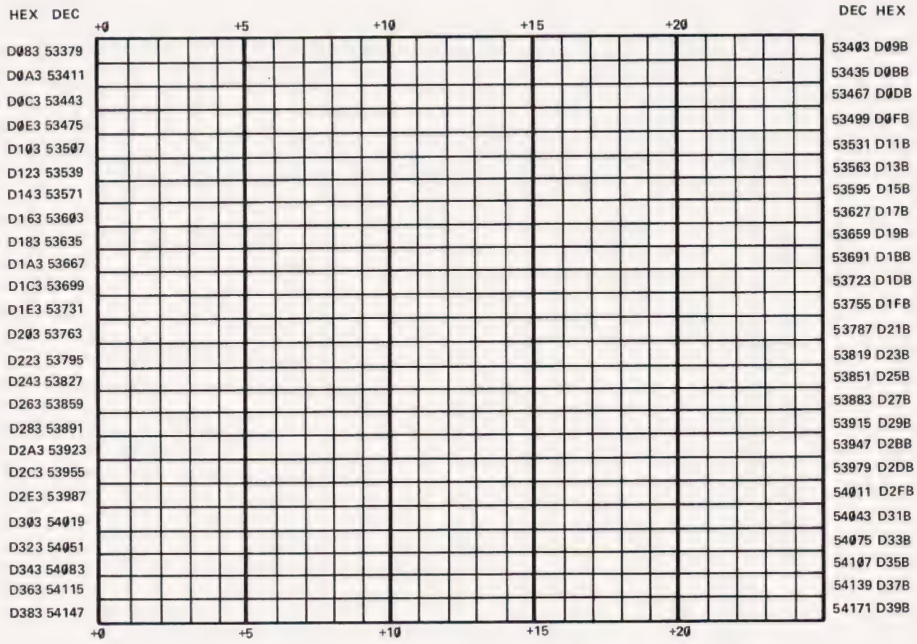
Controlling Codes

There are a number of monitors around for the two computers and Table 1 is intended to show the various cursor and other 'non-printing' functions. The numbers shown are those associated with the CHR$() function.

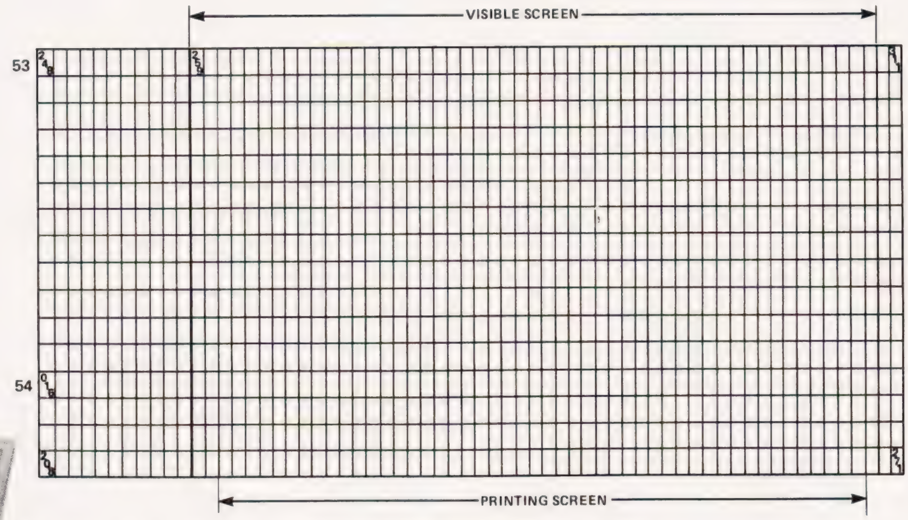
FUNCTION	MON 01	MON 02	CEGMON
Carriage Return	13	13	13
Cursor Left	—	08	—
Cursor Right	—	09	11
Cursor Up	—	11	—
Cursor Down	10	10	10
Home	—	—	12
Clear Screen	—	12	26
Clear Window	—	—	30

Table 1. The 'non-printing' functions for the various monitors.



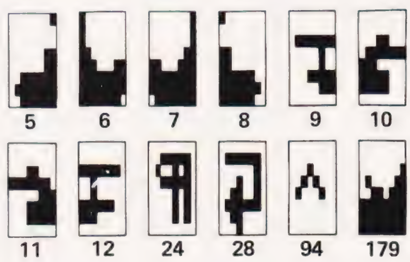


The Superboard II's screen memory map.



The UK101 has a slightly more convoluted arrangement as can be seen from its screen map.

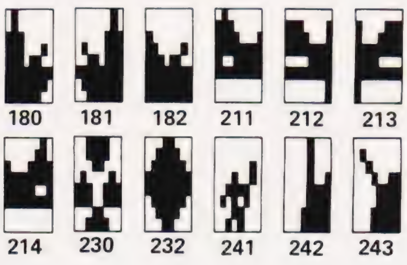
The following 36 characters are from the Superboard II and should be inserted in the table when using that system.

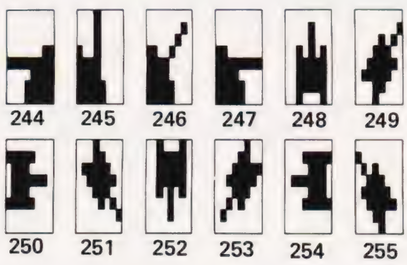


GRAPHIC DETAIL

CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL	CODE	SYM–BOL
0		32		64	@	96		128		160		192	(	224	(
1		33	!	65	A	97	a	129		161		193	^	225	)
2		34	"	66	B	98	b	130		162		194	)	226	O
3		35	#	67	C	99	c	131		163		195		227	
4		36	$	68	D	100	d	132		164		196	<	228	
5		37	%	69	E	101	e	133		165		197		229	♥
6		38	&	70	F	102	f	134		166		198		230	♣
7		39	'	71	G	103	g	135		167		199	\	231	♠
8		40	(	72	H	104	h	136		168		200	\	232	♦
9		41	)	73	I	105	i	137		169		201	/	233	
10		42	*	74	J	106	j	138		170		202	/	234	
11	^	43	+	75	K	107	k	139		171		203		235	
12	≡	44	,	76	L	108	l	140		172		204		236	
13		45	-	77	M	109	m	141		173		205		237	
14		46	.	78	N	110	n	142		174		206		238	
15		47	/	79	O	111	o	143		175		207		239	
16		48	0	80	P	112	p	144		176		208		240	
17		49	1	81	Q	113	q	145		177		209		241	α
18		50	2	82	R	114	r	146		178		210		242	β
19		51	3	83	S	115	s	147		179	⇒	211		243	ω
20		52	4	84	T	116	t	148		180	⇐	212		244	δ
21		53	5	85	U	117	u	149		181		213		245	ψ
22		54	6	86	V	118	v	150		182		214		246	Ω
23		55	7	87	W	119	w	151		183		215		247	
24	£	56	8	88	X	120	x	152		184		216		248	π
25		57	9	89	Y	121	y	153		185		217		249	Σ
26		58	:	90	Z	122	z	154		186		218		250	λ
27		59	;	91	[	123	{	155		187		219		251	ϕ
28		60	<	92	\	124	}	156		188	X	220		252	θ
29		61	=	93	]	125	¦	157		189	/	221		253	ε
30		62	>	94	↑	126	÷	158		190	\	222		254	ν
31		63	?	95	_	127	~	159		191	V	223		255	γ

All these characters make up the UK101's graphic repertoire.

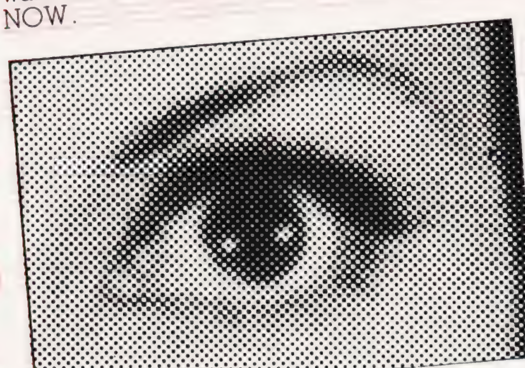




NEXT MONTH

THE REAL THING

Unlike other publications, we are waiting for the REAL BBC Computer before we publish our findings. No half completed prototypes here — our report is going to be on the same system that you'll get through the post, if it arrives in time that is! If all goes well, the March issue will contain a complete analysis of the system, just prior to the second transmission of the BBC series. If you really want the facts, book your copy of next month's issue NOW.



KEEPING AN EYE ON YOU

If you've been following our occasional MICROLINK series, you may have wondered just what to do with all the individual interfaces. Worry no longer because next month we'll be presenting a complete home monitoring package based on these interfaces. Designed to be configured around an Acorn System 1, it can be fitted, with suitable software, to any micro with an eight-bit I/O port. So, if you fancy letting the micro look after your home for you, get your soldering iron warmed up for the March issue of Computing Today.

HANDS-ON LEARNING

Two new training aids have recently been launched onto the market, both based on the Z80 CPU. In a double Special Report, we'll be seeing just how good they are at making users familiar with low-level programming and the concepts of microcomputers.

POSTERS

If you think that you've seen this before, then you're right — we had hoped to get it into our February issue but production difficulties prevented that. To recap, it's a utility program that allows you to print giant text. At the heart of the program are a number of subroutines that allow the size of each letter to be selected before printing; they also define each character's shape from a number of standard pieces.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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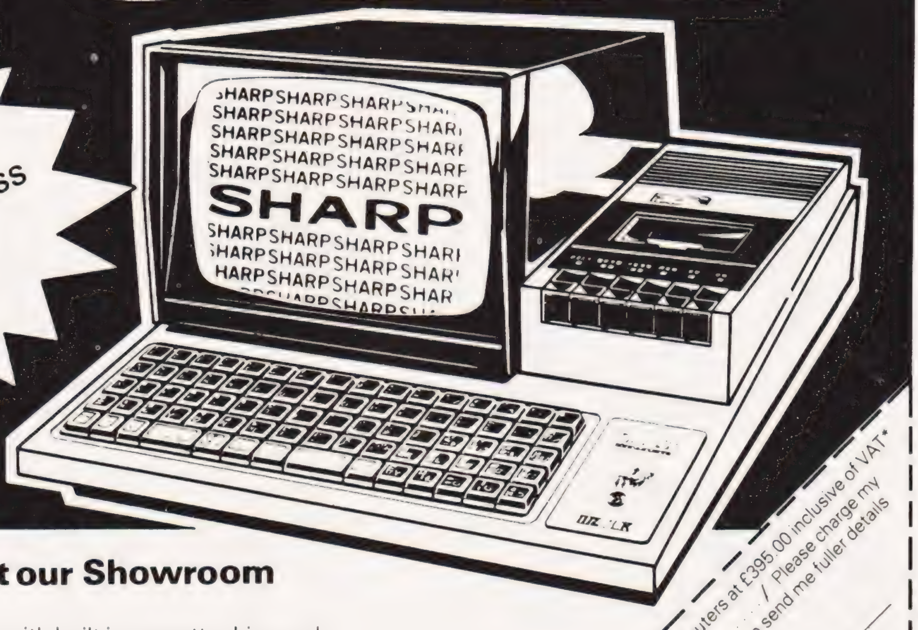

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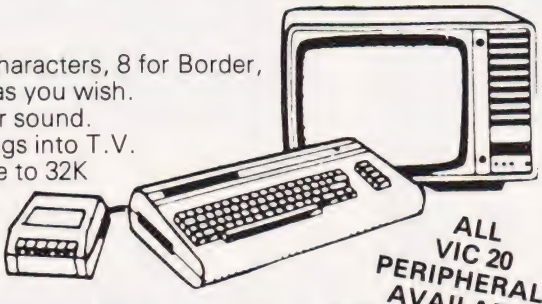

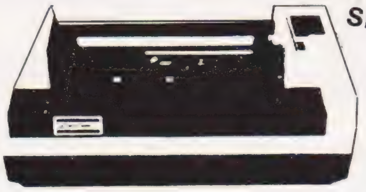

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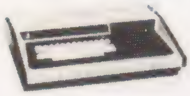

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Access

SORCERER'S GRAPHICS

If you are having problems getting the best out of your user defined graphics facility then you need the following graphic guide.

Writing about Sorcerer graphics looks easy enough at first sight, but one has to approach the matter carefully. There are no less than 18,446,744, 073,709,550,000 different graphics shapes that the Sorcerer can be made to produce, and defining them all would take up a lot of pages which might otherwise be put to better purposes. On the other hand, the shapes could be defined quite briefly by saying that they are based on an 8 x 8 matrix, with any point in the matrix set to black or white. But that would be rather inadequate. Those not familiar with the system would want to know how it was done.

So, as a start, it seems best to explain the underlying mechanics of the system. We must begin by looking at the Sorcerer memory map.

The Memory Map

With a full complement of chips, the Sorcerer RAM extends from address 0 to address BFFF Hex. Above that come the ROM areas, first the 8K plug-in ROMPAC (which can be replaced by a further 8K of RAM, making 56K in all) and then the 4K Monitor. This accounts for 60K of store, and the remaining 4K belong — with minor but significant exceptions — to the display system.

The screen RAM occupies the F000-F7FF Hex address range, and the F800-FFFF Hex segment is devoted to character definition. This means establishing the bit pattern of each character or graphic, eight bytes being required for each definition. The first 128 characters — the standard alphanumeric set — are defined in ROM, the remaining 128 characters can be held in RAM, which is the key point of the whole scheme. Each of these RAM-defined characters is user definable, bit by bit.

Defining 128 characters for each program might prove rather a chore, so the lower half of the graphics range is set up to a series of standard shapes at switch-on and whenever Clear Screen is called, but these can be changed at will in other circumstances.

The screen RAM provides one location for every character position on the 30 x 64 screen, the location being set to the ASCII code for the character or graphic to be displayed. The ASCII code forms part of the address used to access the character-defining ROM or RAM, the remainder of the address being defined by the three least significant digits of the scan line number. This accesses a data byte which is passed to a shift register to generate the data part of the video signal.

Since there are 1920 character positions on the screen, and 2048 locations in the screen RAM chips, there are 128 spare RAM locations, but these need to be used with care, for reasons which will emerge later. The locations F000/1 Hex serve the important purpose of defining the pivot address of the Monitor Stack and Workspace, and other locations are used by certain programs, but the area otherwise tends to be quietly forgotten.

The Display Counters

During normal display action, the screen RAM addresses are provided by the line and frame counters, each of these being a pair of four-bit synchronous counters. The crystal-controlled Master Clock, running at 12.638 MHz, is used directly to control the output of dot elements to the screen; it is divided by two to generate the 6.319 MHz line scan counter drive; it is also divided by six to generate the 2.106 MHz CPU clock.

The line scan counter carry drives a bistable, the output of which is fed back to set the count alternately to 256 and 149. Data is passed to the screen during the count of 256, and the 149 count corresponds to the flyback period. The line sync pulse is generated between the 11th and 43rd counts of the 149 count phase. At every fourth count during the data output phase a pulse is generated to read out another byte to the video shift register.

Frame scan timing is similarly controlled, but the process is complicated by facilities for selecting either a 50 Hz or 60 Hz frame scan by operating a DIL switch. The count is always 240 during the data phase, but the count for the flyback phase is 73 for 50 Hz and 21 for 60 Hz. During this phase the frame sync pulse is output, there being just room for it in the 60 Hz case.

The relatively high dot frequency makes the use of a proper video display desirable and the standard Sorcerer does not incorporate a TV modulator. A fairly satisfactory display can be obtained on a television screen, but precise tuning is needed and drift is often apparent.

Screen RAM Addressing

Since screen RAM addresses run from F080 to F7FF Hex, the Fxxx content can be taken for granted. The next six bits, reading downward, are supplied by the frame scan counter, the three least significant bits of that counter being used as part of the address of the character-defining store, and the six lowest bits of the screen RAM address come from the line scan counter.

Work through it gently, and it may become clearer. It is very obvious that someone put a lot of thought into the design, and it would be ambitious to expect to understand how it works at a glance.

The addresses for the definition store are generated in the same sort of way. The top five bits are all 1; the next eight come from the ASCII code read from the screen RAM; the last three come from the least significant bits of the frame scan count, to indicate which of the eight rows of the character area is being scanned.

Some of the address bits are in fact generated by a special ROM with the endearing name of 'Bruce', which simplifies matters a good deal in hardware terms.

Screen Store Access

When the processor calls an address in the Fxxx area, Bruce switches the display system address and data lines to the main computer bus, and read and write action occurs as with any other area of store. While this is happening, normal service on the video output is suspended, which produces a short black line on the screen. This also happens when any of the spare screen RAM locations in the F000-F07F Hex area are accessed, and that is why this region must be used with caution.

And thereby hangs a minor mystery. According to Victor Tolomei, in his 'Software Internals ▷

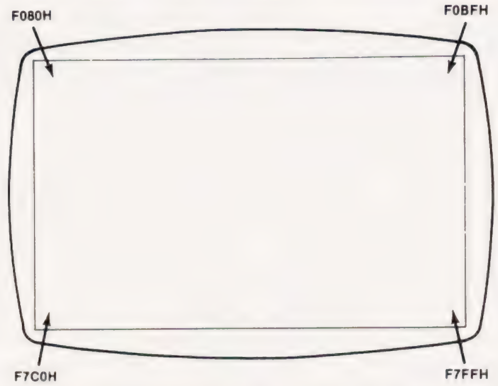

Fig. 1. These are the four corner addresses of the screen. Format is 30 lines of 64 characters so there are 1920 available locations.

Fig. 2. The user-defined graphics set is located from ASCII 192 to 255 and can be directly accessed from the keyboard by using the Shifted GRAPHIC key. The Hex number at the top of the key is the starting address of the character in RAM.

Manual for the Sorcerer', the Monitor routine at E1A2 Hex ensures that reference to the pivot address held in F000-1 Hex can only occur during 'vertical retrace', which is what we would call frame flyback. This is certainly what ought to happen. The routine does check an output of the scan counters, waiting about 50 uS thereafter before accessing F000-1 Hex. But the signal checked is generated by the line scan counter, in fact by the bistable which selects the alternate 256 and 149 counts. The access to F000-1 Hex is held off until the line flyback period, *not* the frame flyback period. Did somebody pick the wrong signal?

The point isn't too important, though it means that there is only time for a brief access before the screen comes alive again, whereas the frame flyback blanking lasts for a much longer period. This means that there is rather more screen flicker, the VIDEO routine also being timed by E1A2 Hex, but the effect is rarely annoying. Indeed, the minor flicker that can be seen during tape loading is quite useful when the FILES facility is in use, as disappearance of the flicker announces that the end of a file has been reached.

Graphics Creation

Suppose a reverse video 'a' is wanted. The coding for a normal 'a' is 00,00 for the two blank lines at the top, then 38, 04, 3C, 44, 3C for the character, and a final 00 blank line at the bottom. Writing out these Hex numbers in binary gives:

```
00000000            --------
00000000            --------
00111000            --XXX---
00000100     OR     -----X--
00111100            --XXXX--
01000100            -X---X--
00111100            --XXXX--
00000000            --------
```

Complement each byte, to give FF, FF,C7,FB,C3,BB,C3,FF, and the black and white areas change places. This can be done most simply by using the original 'a' coding (stored in ROM) as a basis, when the following BASIC program will set up the reversed character on the key which normally produces lower case 'a':

```
10  FOR X=1 TO 8
20  A=255-PEEK(X-1273)
30  POKE(X-817),A
40  NEXT X
```

The eight locations starting at −1272 are read, inverted, and set in the eight locations starting at −816. The first location is determined by multiplying the ASCII codes for the required character by eight and then subtracting 2048. The second is listed in the Sorcerer BASIC Manual.

Press the 'A' key with the shift lock off, and 'a' will appear normally. Now press the graphics key as well, and the reversed form will appear. However, a Clear Screen will cause the character to revert to a quarter circle in the upper left-hand corner of the character space. Run the program with this character showing on the screen, and you will see it change, line by line, to a reversed 'a'.

As noted at the start, each graphics character can be set to an astronomical number of forms, and it would be pointless to try to describe the possibilities, which are only limited in practice by the ingenuity of the user. Since adjacent character areas touch, both vertically and horizontally, a number of characters can be combined to form a single shape. For that matter, a whole area covered by 128 characters can be defined dot by dot.

A major graphics definition session can become quite protracted, but fortunately there are software aids which help the process along, by showing the character shape enlarged and allowing each dot position to be defined by simple keyboard inputs. Some such programs are a little over-complicated, being planned to allow major pictures to be created, but others are simple and workman-like. Unfortunately, their originators have not signed their work, so the best are difficult to locate. In matters like these, the European Sorcerer Club (ESCape) can be a great help. (Write to Colin Morle, 32 Watchyard Lane, Formby, Nr Liverpool.) Their members are hard at work producing more and more complicated extensions to Screenprint, recently described in Computing Today.

Before leaving the subject of 'created' graphics, it is worth mentioning that an approximation to the six-pixel graphics of the Tandy type can be obtained by the following sort of pattern:

```
XXXX----
XXXX----
--------
----XXXX
----XXXX
--------
XXXX----
XXXX----
```

SORCERER'S GRAPHICS

Standard Graphic Forms

The 64 standard graphic forms set up in the lower half of the graphics RAM area at switch-on and after Clear Screen are listed against the appropriate codes in the major table (including the ones not normally seen) as the video routine does not put ASCII characters of value less than 20 Hex on the screen. They can be brought out by direct screen access, however; a facility which allows any section of code to be moved into screen RAM. One thoroughly unfair use of this is to explore 'Adventure' programs for character strings which might give useful hints! Every character other than space shows up in one form or another.

If the Sorcerer graphics system has a disadvantage, it is the amount of time we are tempted to spend in exploring its boundless possibilities! It does not attempt to compete with true high resolution systems, which may be so complex that they need processors of their own; or with colour, which would probably waste even more of our time, without necessarily producing results of greater practical value. It does, however, provide a valuable addition to the Sorcerer's other capabilities.

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0		32		64	@	96	`	128		160		192		224	
1		33	!	65	A	97	a	129		161		193		225	
2		34	"	66	B	98	b	130		162		194		226	
3		35	#	67	C	99	c	131		163		195		227	
4		36	$	68	D	100	d	132		164		196		228	
5		37	%	69	E	101	e	133		165		197		229	
6		38	&	70	F	102	f	134		166		198		230	
7		39	'	71	G	103	g	135		167		199		231	
8		40	(	72	H	104	h	136		168		200		232	
9		41	)	73	I	105	i	137		169		201		233	
10		42	*	74	J	106	j	138		170		202		234	
11		43	+	75	K	107	k	139		171		203		235	
12		44	,	76	L	108	l	140		172		204		236	
13		45	-	77	M	109	m	141		173		205		237	
14		46	.	78	N	110	n	142		174		206		238	
15		47	/	79	O	111	o	143		175		207		239	
16		48	0	80	P	112	p	144		176		208		240	
17		49	1	81	Q	113	q	145		177		209		241	
18		50	2	82	R	114	r	146		178		210		242	
19		51	3	83	S	115	s	147		179		211		243	
20		52	4	84	T	116	t	148		180		212		244	
21		53	5	85	U	117	u	149		181		213		245	
22		54	6	86	V	118	v	150		182		214		246	
23		55	7	87	W	119	w	151		183		215		247	
24		56	8	88	X	120	x	152		184		216		248	
25		57	9	89	Y	121	y	153		185		217		249	
26		58	:	90	Z	122	z	154		186		218		250	
27		59	;	91	[	123	{	155		187		219		251	
28		60	<	92	\	124	¦	156		188		220		252	
29		61	=	93	]	125	}	157		189		221		253	
30		62	>	94	^	126	~	158		190		222		254	
31		63	?	95	_	127		159		191		223		255	

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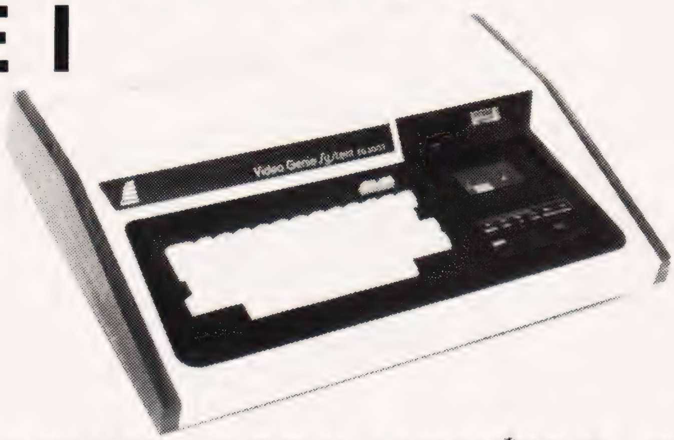

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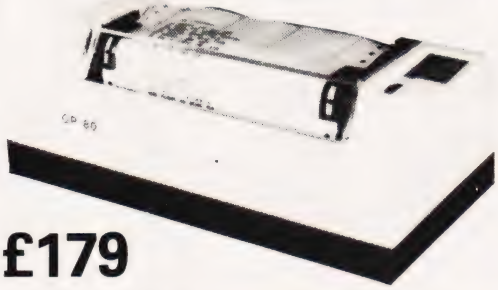

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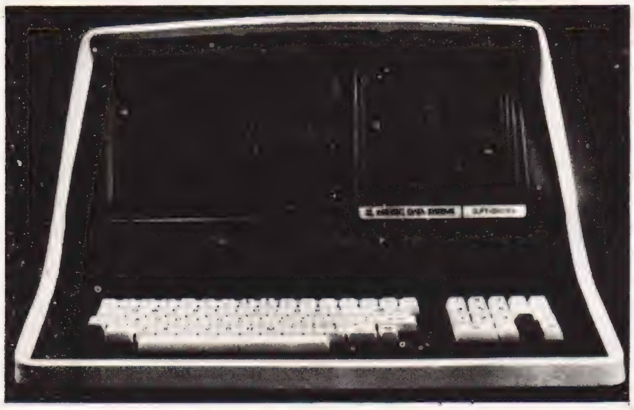

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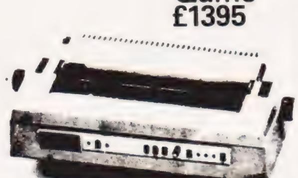

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The day is coming when you can not only order your programs through Prestel, you can also load them into your micro at the same time. We explain the system and its current development.

If you have to travel miles to your nearest software supplier, or get tired of typing pages of listings, or of waiting for programs to arrive through the post, or just don't know how to find out what is available; telesoftware could be the answer.

There are several organisations currently involved in telesoftware, among them the BBC Computer Literacy scheme, the Telesoftware and Education Project based at Brighton Polytechnic, Practical Computing magazine and the Council for Education Technology (CET). This article describes the work CET is doing in the field.

In education a large, and growing, number of Computer Aided Learning (CAL) packages are now available, but distribution of these programs remains a problem. Teachers have difficulty finding out what is available, and whether, once found, a program will run on their machine. Then they have to fill out complicated order forms and wait for the discs or cassettes and associated documentation to arrive.

Telesoftware could provide a simple, quick and effective distribution service. In the longer term it could become the easiest way for domestic users, as well as educational institutions, to obtain programs.

The Service Requirement

The term 'telesoftware' can be used to describe various forms of long distance transfer of information from one computer to another, either through the telephone network, or broadcast over a Teletext system such as Ceefax or Oracle. The system developed by Mike Brown at CET uses Prestel, British Telecom's implementation of the Viewdata system (see On-Screen Info in the December issue of Computing Today). A library of programs and information about them is stored on the central database. With the necessary operating software and a modem to link it to the telephone network, a microcomputer can be used as an intelligent terminal to automatically access, store and run the programs. In addition to receiving telesoftware the micro can perform virtually all the normal Prestel terminal functions, though not in colour. The cost of adapting a micro, (assuming you are fortunate enough to have one already), is considerably cheaper than buying a standard Prestel terminal.

At present CET has only developed operating software for the RML 380Z, chosen because it is one of the most popular microcomputers used in schools, but it is planned to extend this shortly to other machines widely used in education, including those being supported by the Department of Industry. The 380Z package will be commercially available from Research Machines Ltd early in 1982. In addition Prestel adaptors for various microcomputers are now coming on to the market. It would be relatively simple to add a capacity to receive telesoftware to these adaptors. The BBC Computer, for example, will have an optional Teletext and Viewdata telesoftware adaptor available.

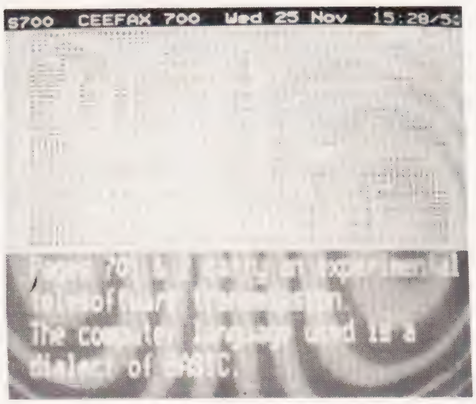
As a means of distribution, telesoftware has many advantages over conventional methods, ie it is very fast. A typical 9K CAL program can be brought down on to disc and be ready to run within five minutes. The actual distribution cost of this — the telephone call and the Prestel computer connection charge — compares very favourably with the cost of sending the program by post. In addition, automatic error checking, built in to the transmission, ensures that there is virtually no danger of corruption from telephone line noise and avoids the damage that can occur through bad handling or magnetic fields when discs and cassettes are sent by post. Because programs are stored on the Prestel database, they can be easily updated, so the latest version should always be available. Documentation and associated learning materials can be ordered


```
CET                              21143010a   0p
  CET Educational Telesoftware Project
  Monte Carlo Method for pi   LISTING

10 REM PI (evaluating Pi by montecarlo
    method) ver 2 W Tagg Nov 79
20 CLEAR 100
30 PRINT "Evaluating Pi"
40 PRINT "============="
50 INPUT "Slow or Fast";A$
60 IF LEFT$(A$,1)="F" THEN LET L=20
    ELSE IF LEFT$(A$,1)="S"
      THEN LET L=200
        ELSE GOTO 50
70 GRAPH1
80 FOR Y=20 TO 40:PLOT 15,Y,1:NEXT Y
90 FOR X=15 TO 58:PLOT X,30,1:NEXT X
100 PLOT 11,29,ASC("P"):PLOT 13,29,105
110 FOR I=0 TO 43*L STEP L
120 RANDOMIZE
            .............continued: key _
   key 9 for CET Telesoftware index
```

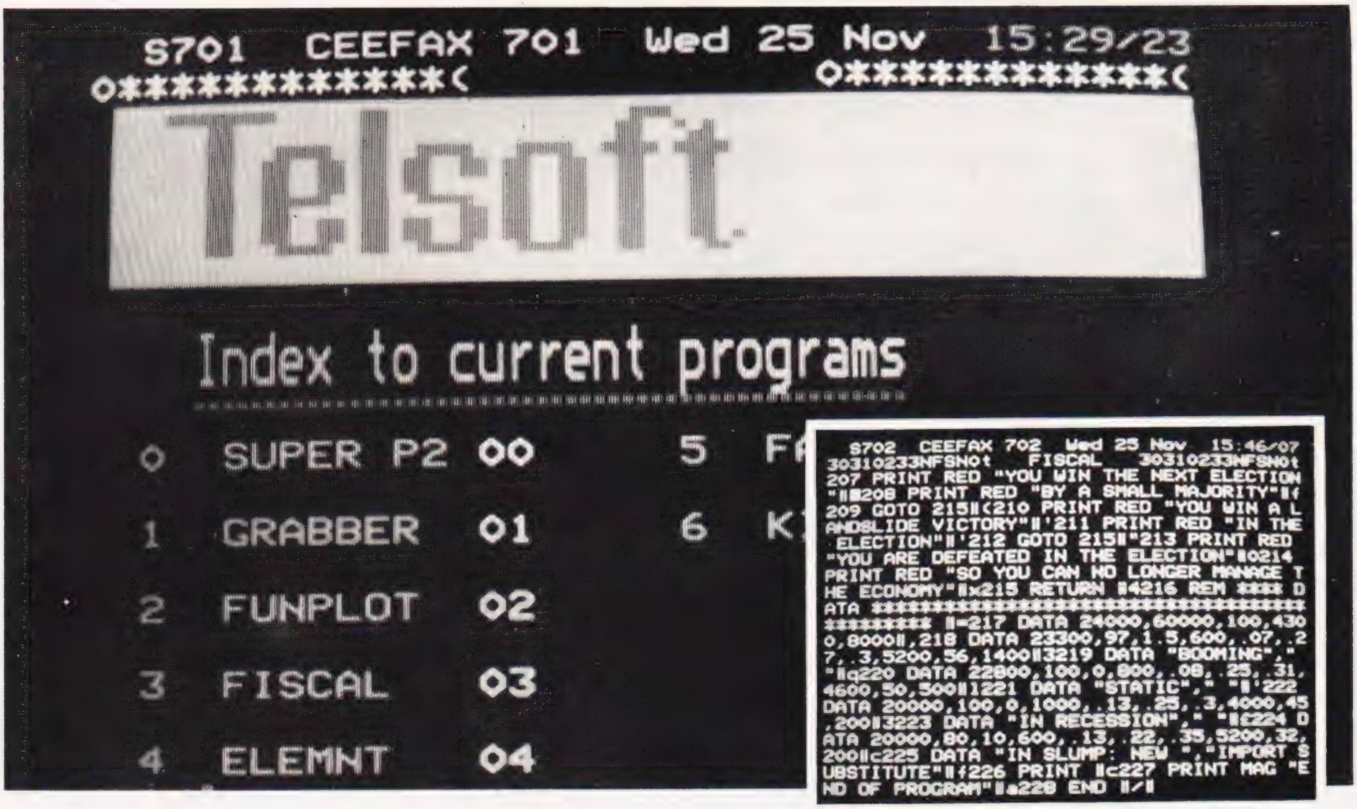
```
CET                              2114301b     0p
|A10}REM}PI}(evaluating}Pi}by}montecarlo
}method)}ver}2}W}Tagg}Nov}79|L20}CLEAR}1
00|L30}PRINT}"Evaluating}Pi"|L40}PRINT}"
============="|L50}INPUT}"Slow}or}Fast";
A$|L60}IF}LEFT$(A$,1)="F"}THEN}LET}L=20}
ELSE}IF}LEFT$(A$,1)="S"}THEN}LET}L=200}E
LSE}GOTO}50|L70}GRAPH}1|L80}FOR}Y=20}TO}
40:PLOT}15,Y,1:NEXT}Y|L90}FOR}X=15}TO}58
:PLOT}X,30,1:NEXT}X|L100}PLOT}11,29,ASC(
"P"):PLOT}13,29,ASC("¡")|L110}FOR}I=0}TO
}43*L}STEP}L|L120}RANDOMIZE|L130}FOR}J=1
}TO}L|L140}LET}X=60*RND(1)|L150}LET}Y=60
*RND(1)|L160}IF}(X-30)↑2+(Y-30)↑2<900}TH
EN}GOTO}190|L170}LET}K=K+1|L180}PLOT}X,Y
,2|L190}NEXT}J|L200}LET}P=4-4*K/(I+L)|L2
10}PRINT}TAB(T);P;|L220}IF}T<>30}THEN}LE
T}T=T+10}ELSE}LET}T=0:PRINT|L230}LET}P1=
INT(100*(P-3.14159)+.5)|L240}IF}P1=0}THE
N}LET}C=0}ELSE}LET}C=1|L250}IF}P1<25}AND
}P1>-25}THEN}PLOT}I/L+15,30+P1,C|L260}NE
XT}I|L270}GRAPH}0|L|F|Z 44
```

Three examples of CET pages on Prestel.



The BBC's Ceefax-based Telesoftware experiment uses the tokenised form of listing.

TELESOFTWARE EXPLAINED



easily through the use of a response frame. Program description and technical details are included on introductory pages, so users can survey what is available and see if it is suitable for their own machine before they decide to buy. There are also advantages for the program supplier. There is no postage and packing, no need to supply a new disc or cassette for every program, and instead of invoicing each user direct, charging can be handled through Prestel's automatic billing mechanism.

Some Drawbacks

Of course, there are problems. Many programs cannot be used properly without documentation, which still has to be sent by post, so you may obtain the program instantly by telesoftware, but be unable to use it for several days until the documentation arrives. Ideally programs avaiable via telesoftware would be fully selt-documenting. Difficulties also arise from the lack of standardisation. Because micros often use different dialects of BASIC, as well as each having their own special features, programs written for one machine may need to be substantially revised before they will work on another. This means that, for each machine which can receive telesoftware, a different version of the program has to be inserted in the database. This is expensive and is one reason why the CET system is at present only available for the 380Z. The absence of a standard method of naming, identifying and cataloging programs can also cause complications.

It would be possible to simply display a listing of the program on the screen, which you then either print out or copy down and type in to your own micro. This is rather laborious and it is obviously much simpler and easier to distribute the program automatically, which is what the CET system does. All the user has to do is press two keys, (CONTROL and T on the 380Z), and the program is automatically downloaded from Prestel, saved on disc and ready to run. In order to achieve this, the program has to be converted to a special format on loading on to Prestel, and then reconverted back into its standard form by the receiving terminal. In theory any Information Provider on Prestel could distribute telesoftware for use on any microcomputer. If all who did this chose different formats for their programs, the user would need a different conversion routine on his own machine for each supplier from whom he wanted to obtain software. In an attempt to avoid the confusion which would result, CET, after consultations with a number of computer manufacturers, software agencies and representatives from Prestel, has developed standard format recommendations for telesoftware on Prestel. A copy of these can be obtained on application to CET.

Project Evaluation

Now that a system exists which is capable of transmitting and receiving telesoftware, CET is concerned to discover its value in education and to achieve this they are running a two-year evaluation project. Twenty-five schools and colleges are being provided with modems, cables and operating software to use in conjunction with their own microcomputers. Other institutions can participate in the trial at their own expense. The main aims are to provide a simple distribution service to education for computer software, to collect feedback on the system from people directly involved in the schools and colleges and to investigate the costs involved, including the actual cost of distribution, methods of pricing and ways of reimbursing the program suppliers. Liaison will also be maintained with other developments in the field of telesoftware.

There are at present 20 programs on the central database, but this will rise to 50 shortly and even more in due course, if costs permit. CET does not provide any programs itself, but is obtaining them from well established CAL suppliers such as the Schools Council, the Central ▷

TELESOFTWARE EXPLAINED

Program Exchange and the Hertfordshire Advisory Unit for Computer Based Education (AUCBE). The institutions taking part in the trial should, therefore, have a choice of tried and tested programs. The current selection covers a wide range of subjects, including, for example, Home Economics and Agriculture, as well as Maths and the sciences. The level ranges from simple learning games to simulations of sophisticated 'A' level experiments. They are all written in BASIC, but this is a reflection of what is currently available. It would be quite possible to transmit software in other languages. It would also be possible to include data files and computational routines as well as standard CAL packages.

The library of programs is supported by a number of introductory pages. These provide general information about telesoftware, describe the CET project and give information on how to use the service to those already able to receive telesoftware. A subject index routes the user to the individual programs. At the start of each program two pages provide a description and technical details. They show, for example, the size and cost of the program, what documentation and associated learning materials are available, and any special features required, such as a printer or access to files. The user should be able to obtain all the information he needs in order to decide whether or not to buy the program. Even if he does not buy, he can still obtain valuable information about the range of CAL programs available by browsing through the introductory pages.

The cost of the system can be divided between equipment and running costs. The installation cost, including a British Telecom Datel 600 modem, a barrier cable and the operating software, is around £150 to educational users. In addition there is a quarterly rental for the modem and the Prestel Business User's charge, which schools also have to pay. Together these come to £52 a quarter. The running costs consist of three elements. Provided you can obtain Prestel at local call rates, the normal telephone charge and the Prestel computer connection charge amount currently to 6p a minute at peak rate, but just under 2p a minute at cheap rate, If you are part of the 38% of the population unable to receive Prestel on a local call, you have to pay the appropiate STD rate. The third charge is the Prestel frame charge — the cost of the program itself. This is left to the discretion of the program suppliers but will, in general, correspond to the normal charge for the program if obtained through any conventional method. There is no frame charge on the introductory pages.

The Future

Telesoftware is in its infancy. CET hopes that within two years there will be a choice of telesoftware available from many sources, not just the CET library. But what really matters is not the ability to make vague predictions about the future, or merely to explore what is technically possible, but to discover how telesoftware can best be used in the field of education.

If you want to know more, and get the latest information, why not look at page 2114 on Prestel? You can also write to the CET at 3 Devonshire Street, London W1N 2BA.

USING APPLE'S GRAPHICS

Mike James

The Apple offers three display modes; text, low and high resolution graphics. What are they and how do they work? Read on for the revelations.

The Apple was the first personal computer to have any graphics capabilities. I remember finding the early glossy colour advertising for the system unbelievable because it was so far in advance of its competitors in terms of presentation and performance. Now we have colour boards for the S100 bus and machines such as the ATARI 800 and the DAI, all offering high resolution and easy-to-use graphics, but the Apple still has a lot to offer.

If you have an Apple, this article will help you understand its graphics capabilities and therefore make the most of them. If you are thinking of buying a micro, graphics is, of course, an important factor to bear in mind so read on to see what the Apple has to offer.

Apple's Graphic Features

The system has three distinct display modes; TEXT, LOW-RESOLUTION GRAPHICS and HIGH-RESOLUTION GRAPHICS. When first switched on, the Apple starts out in TEXT mode displaying just 24 lines of 40 characters. This is probably one of the most disappointing features of the Apple. Not only are you restricted to 40 characters per line, but there is no lower case! It seems odd that a machine that is so good at graphics is so bad at text but then, you can't win 'em all! In Low-Res graphics mode you can display any number of blocks from an array 40 blocks wide and 48 blocks high. A block can be any of sixteen different colours, although, of course, you need a colour TV to see them. Low-Res graphics are easy to use, fast and ideal for simple games programs such as tennis, squash etc. Their obvious disadvantage is that it is not possible to draw precise shapes. If you enter High-Res graphics mode (how to comes later), you can plot any of an array of 280 dots wide by 192 dots high. Dots can be any one of six colours but not every dot can be any colour. There is a limitation to the colour TV which means that not every colour is available at every position and displaying two points in different colours side-by-side, results in white! Because of these considerations, colour in High-Res graphics is difficult to use reliably and we will concentrate on black and white graphics. High-Res graphics are very good for drawing graphs and line diagrams but anything complicated can be a little slow and shading-in areas of continous tone is painfully slow. Although High-Res graphics is the most difficult of the Apple's graphics modes, it is also the most exciting and rewarding to work with. Adjacent blocks have no space between them so continuous areas of colour can be constructed.

As well as the three 'pure' modes, the Apple can work in a mixed graphics and text mode rather than the pure graphics. If you want either pure Low-Res graphics or pure High-Res graphics from APPLESOFT then you have to use a PEEK (see the Apple manual for details, Table 1 gives a summary).

Another feature of the display modes is that each has two pages. This means that you can write information to one page while displaying the other and then suddenly flip pages, thus making the new information appear. This can be useful for animation and generally speeding up display presentation. Under APPLESOFT, page two of Low-Res graphics can only be reached via a POKE but page two of High-Res can be invoked via an HGR 2 statement. Unlike HGR, HGR 2 gives a pure graphics mode, ie no four lines of text at the bottom of the screen.

Graphics In General

Now that we know the sort of thing that the Apple can do, let's pause a moment and consider the way other micros tackle the graphics problem. Some micros (such as the PET) have adopted a very different approach to graphics. Instead of allowing the user to plot small points or blocks and then build up shapes, the PET supplies a set of graphics characters. This reduces the amount of memory used to store any display. It also allows a free mixing of graphics and alphanumeric characters anywhere on the screen. The disadvantage of this method is that you depend on the machine's designer to supply you with all the shapes that you need — ie battleships, rockets etc. and you have the problem of fitting them together to make bigger shapes. For example, I remember trying to draw a square on the screen of a PET and spending hours trying to find the correct graphics character to complete a corner without leaving a gap. It is true that I found the beast after a rest and a coffee, but it brought home how much I was at the mercy of the available character set! Not so on the Apple, however. A basic Low-Res character is simply a solid rectangular block — no hunting for shapes, you can either plot a block or leave it off. This is easy to use but the shapes that you can display are limited. To deal with shapes such as diamonds, hearts, spades and clubs you really have to go to High-Res graphics. Although the range of shapes you can make in High-Res mode is unlimited, drawing a common but complicated shape such as a heart is not easy and there have been times when it would have been nice to have a PET-style graphics set built-in.

There is one innovation that was introduced by the Apple which provides a link between the two graphics methods; the shape table — but more of that later.

Co-ordinates

Using either of Apple's graphics modes depends on an understanding of co-ordinates. Among the questions most often asked by someone new to Apple graphics are, "how do I plot a diagonal line in Low-Res?", and "how do I plot a circle in High-Res graphics?" The answer to both of these questions lies in the use of co-ordinates and co-ordinate geometry. If the introduction of the word 'geometry' has you remembering school and hence about to turn to another article, take courage and read on. Co-ordinate geometry is not about theorems and proofs but is about how to generate or draw geometric figures such as circles, ellipses, etc.

The best way to understand co-ordinates is to imagine a chess board. Starting from the top left-hand corner, count off each column starting at 0 and then count off each row starting at 0. Now if you are asked to label any square you should have no trouble. This is all there is to the idea of a co-ordinate. By tradition, the first co-ordinate that you give is the column number and the second the row number — so 3,6 means column 3 row 6. Also by tradition, the column number is called the x co-ordinate and the row number is called the y co-ordinate. Two important things to notice are that all the squares in the same column have the same x co-ordinate and all the squares in the same row have the same y co-ordinate. Moving horizontally across the board changes x and leaves y fixed and moving vertically changes y but leaves x fixed.

The Apple uses two co-ordinate systems. In Low-Res graphics the screen is divided into an array of 40 columns by 48 rows. As with the chess board example, the numbering starts in the top left-hand corner of the screen with 0,0 making the block in the lower right-hand corner 39,47. If four rows of text are used at the bottom of the screen then the maximum y co-ordinate is reduced to 39.

In High-Res graphics the screen is divided into an array of dots 280 by 192, once again with 0,0 in the top right hand corner. The maximum co-ordinates (ie the bottom right-hand corner) is therefore 279,191. If four lines of text are included, then the maximum y value is reduced to 159. Details of the memory maps can be seen in Table 2.

Low-Resolution Graphics

After some theory it's time to look at how Apple handles Low-Res graphics. First we will go over the standard Low-Res commands and explain how they are used. In the next section a program will provide a practical demonstration of how the instructions can be used together to produce the sort of games so often seen on the Apple.

The first Low-Res graphics command that we need is GR. This switches the Apple to mixed text and Low-Res grapics mode and clears the screen. Once in Low-Res the colour of the next and subsequent plotted points is set by

```
COLOR=arithmetic expression
 (note American spelling)
```

The arithmetic expression must evaluate to a number in the range 0 to 15. the range of colours can be seen in Table 3. but the most often used are 0 for black and 15 for white. To plot a point in the currently selected colour, use

```
PLOT arithmetic expression 1,
     arithmetic expression 2
```

The first arithmetic expression is the x co-ordinate of the point and the second is the y co-ordinate. The following program illustrates the use of these three commands:

```
10  GR
20  INPUT X,Y,C
30  COLOR=C
40  PLOT X,Y
50  GOTO 20
```

This program will let you enter the x and y co-ordinate and colour of a point to be plotted. Try using it to explore the screen and see what happens if you try to plot in the text area or outside the screen altogether. It is important to realise that you can alter the colour of a point only by replotting it. (Some machines have an UNPLOT command instead). For example, if you want to make a point flash on and off:

```
10  GR
20  COLOR=15
30  PLOT 30,30
40  COLOR=0
50  PLOT 30,30
60  GOTO 20
```

To make the point flash slower put a FOR. . .NEXT loop in between lines 30 and 40 and lines 50 and 60. (Why do you need two delays?)

It is obvious that plotting horizontal or vertical straight lines is something that we need to know how to do in Low-Res graphics. Although it is possible to plot lines using only the PLOT command, APPLESOFT provides two special commands VLIN and HLIN which plot vertical and horizontal lines in the selected colour much faster than the equivalent set of PLOTs. To specify a vertical line you have to say which y co-ordinates it starts and finishes at (ie its length) and which position on the screen it is at (ie its x co-ordinate). The form of the VLIN command is thus:

```
VLIN starting y co-ordinate,
     finishing y co-ordinate AT
     x co-ordinate
```

It should come as no surprise that the form of the HLIN command is

```
HLIN starting x co-ordinate,
     finishing x co-ordinate AT
     y co-ordinate
```

For example, to draw a square

```
10  REM**PLOT A SQUARE WITH
30  REM**CORNERS AT 10,10 AND 20,20
30  GR
40  COLOR=15
50  HLIN 10,20 AT 10
60  HLIN 10,20 AT 20
70  VLIN 10,20 AT 10
80  VLIN 10,20 AT 20
```

A command that deserves more attention than it usually receives is SCRN. The command

```
C=SCRN (x co-ordinate,
        y co-ordinate)
```

returns the colour of specified point on the screen. As we will see in the next section it can be used for some very interesting dynamic graphics.

As an example of Low-Res graphics the following program plots a sort of pin ball board and then bounces a 'ball' around the screen. It is not a complete game but provides the starting material for a number of different games which the reader may care to develop himself.

```
  10  GR
  20  GOSUB 1000
  30  X=35
  40  Y=RND(1)*39
  50  HV=1
  60  VV=1
  70  GOSUB 2000
  80  GOTO 70
  90  END
1000  COLOR=15
1010  HLIN 0,39 AT 0
1020  HLIN 0,39 AT 39
1030  VLIN 0,39 AT 0
1040  VLIN 0,39 AT 39
1050  VLIN 8,12 AT 5
1060  VLIN 18,22 AT 5
1070  VLIN 28,32 AT 5
1080  PLOT 10,15
1090  PLOT 10,16
1100  PLOT 10,25
1110  PLOT 10,26
1120  PLOT 15,20
1130  PLOT 15,21
1140  PLOT 20,20
1150  PLOT 21,20
1160  PLOT 20,10
1170  PLOT 20,30
1180  VLIN 0,11 AT 30
1190  VLIN 39,28 AT 30
1200  RETURN
2000  COLOR=0
2010  PLOT X,Y
2020  COLOR=15
2030  X=X-HV
2040  Y=Y-VV
2050  IF SCRN(X,Y)=0 THEN PLOT X,Y:
      HFLIP=0:RETURN
2060  IF HFLIP=0 THEN HFLIP=1:
      X=X+HV:Y=Y+VV:HV=-HV:
      GOTO 2030
2070  VV=-VV
2080  HV=-HV
2090  X=X-HV
2100  Y=Y-VV
2110  HFLIP=0
2120  GOTO 2030
```

The main part of the program (lines 10 to 90) simply sets up starting values and calls subroutines. The first subroutine draws the pin ball board using a list of HLIN, VLIN and PLOT commands. The method used is straightforward and the reader should be able to alter the board layout without any trouble. The starting co-ordinates for the 'ball' are set up in lines 40 and 50, the x co-ordinate being random between 0 and 39. Lines 50 and 60 set the horizontal and vertical velocities (VV,VH) to 1. The values of VV and VH govern the distance and direction that the 'ball' will move at each step. Lines 70 and 80 call the 'move ball' subroutine repeatedly. If the ball moves too fast for your game, then slow it down with a FOR. . .NEXT loop at line 75. The move ball subroutine is the heart of the program. It moves the ball from X,Y to X-VH,Y-VV by first unplotting the existing ball position (line 2010) and then plotting the new ball position. Before the new position is plotted, it is checked to see if it is free, ie is black (line 2050) using the SCRN function. If it isn't free then it is part of the border or an obstacle and the ball cannot move into that position. When the ball hits an area of white its direction changes. Either the vertical velocity is reversed (VV = − VV) or its horizontal velocity is reversed (VH = − VH) but not both. The way that this program achieves this 'bouncing' effect is a little unusual. At line 2080 the horizontal velocity is reversed and HFLIP is set to 1 to record this fact. The ball's position is now returned to its old value and a GOTO 2030 causes the program to try to plot the ball's new position. If this is yet again blocked by a white square then the horizontal velocity and the ball's position are returned to their previous values and the vertical velocity is reversed in another attempt to find a free location. All this might seem very complicated but it does mean that the ball will bounce its way around a screen full of whatever objects you care to plot in subroutine 1000.

The program can be extended to cope with different sorts of collision by plotting obstacles in different colours and using SCRN to test what should happen when the ball tries to move into an occupied location. (For example, you could increase the velocities when the ball strikes a red obstacle.)

High-Resolution Graphics

As mentioned earlier, High-Res graphics is difficult to use but the effects it can achieve are well worth the trouble. To enter a mixed High-Res and text mode the command HRG should be used. If you want a pure High-Res screen then the command HGR 2 should be used instead, but notice that graphics page 2 is used. Either HGR command clears the screen before allowing you to plot using the colour selected by the HCOLOR = instruction. As discussed earlier, the use of colour in High-Res graphics is a tricky subject and needs an article all to itself, so we will assume that all graphics will be in black and white. The High-Res equivalent of PLOT is

```
HPLOT x co-ordinate, y co-ordinate
```

although it is not used as much as PLOT because a single high resolution point is very small indeed. The work-horse instruction for High-Res is the extended HPLOT command:

```
HPLOT start x co-ordinate,
      start y co-ordinate  TO
      finish x co-ordinate,
      finish y co-ordinate
```

This will plot a line from the starting co-ordinates to the finishing co-ordinates. Horizontal and vertical lines are now special cases of the general line drawing. For example to draw a line from 40,10 to 100,90 use

```
HPLOT 40,10 TO 100,90
```

When drawing diagonal lines it is sometimes disappointing to see the rough and ragged result looking more like a bolt of lightening rather than a straight line! There is nothing that can be done about this except to buy a computer with still higher resolution graphics. If you can put up with lines that aren't solid then I find that it is better to plot only the points that lie exactly on the line and leave the eye to fill in the gaps. This is often the best way to plot graphs and curves to look smooth. For example, consider the two lines plotted by the program given below:

```
  1  HGR2
  2  HCOLOR=3
 10  X1=0
 20  Y1=50
 30  X2=259
 40  Y2=73
 50  ACC=.1
 60  HPLOT X1,Y1 TO X2,Y2
 70  M=(Y2-Y1)/(X2-X1)
 80  FOR I=X1 TO X2
 90  Y=M*I+80
100  D=Y-INT(Y)
110  IF D<ACC THEN HPLOT I,Y
120  NEXT I
```

The first line is plotted as a solid line using the HPLOT command and the second line only plots those points that are within a distance ACC of the true line. I leave you to choose which is better for your application.

The HPLOT command has two more ways in which it can be used. First, if you only give a pair of finish co-ordinates, then the last plotted dot is taken to be the start of the line, for example:

```
10  HPLOT 10,10
20  HPLOT TO 100,90
```

is the same as:

```
10  HPLOT 10,10 TO 100,90
```

Second, you can carry on an HPLOT command with as many TO final co-ordinate pairs as you can type. Each time a TO is encountered a line is drawn from the last pair of co-ordinates to the pair following the TO. An example might help to make this clear.

```
10  HPLOT 10,10 TO 100,90 TO 60,60
```

is the same as:

```
10  HPLOT 10,10 TO 100,90
20  HPLOT 100,90 TO 60,60
```

Some Useful Shapes

There are two ways of using High-Res graphics — you can list and plot every point you're interested in (in which case you'd do well to invest in a light pen or a graphics tablet) or you can generate the shapes that you need by the use of formulae. To illustrate the point, consider the problem of plotting a circle. You could store the co-ordinates of every point on the circle in an array and then plot every point, or you could use the equation that defines a circle to generate each point in turn. If you need to draw a very complicated shape then you have little choice but to buy a light pen! Most graphics applications require nothing more than straight lines, circles and ellipses so it's worth knowing how to draw them.

Drawing straight lines in APPLESOFT is easy. All you have to do is use the HPLOT command but how do you draw a curve? The answer is to draw a number of straight lines that lie as close to the curve as posible. For example, if we consider the circle drawing problem, co-ordinate geometry tells us that any point on the circle is given by an x co-ordinate of rCOS(theta) + x and a y co-ordinate of rSIN(theta) + y where r is the radius of the circle centred at x,y. As theta goes from 0 to 2*PI every point on the circle is generated and we could use this fact to plot a sufficiently large number of points to give the impression of a continuous curve. This is what the following program does:

```
  1  HGR2
  2  HCOLOR=3
 10  PI=3.14159
 20  X=100
 30  Y=100
 40  R=60
 50  INC=.09
100  FOR THETA=0 TO 2*PI STEP INC
110  HPLOT R*COS(THETA)+X,
     R*SIN(THETA)+Y
120  NEXT THETA
```

or we could plot a smaller number of points and join them up using straight lines. If you make the following changes to the first circle program you will arrive at a program that plots straight lines between the points that the first program plotted.

```
100  FOR THETA=0 TO 2*PI-INC
     STEP INC
110  HPLOT R*COS(THETA)+X,
     R*SIN(THETA)+Y TO
     R*COS(THETA)+X,R*SIN(THETA)+Y
120  NEXT THETA
130  HPLOT TO R+X,Y
```

If you can, use both versions of the program to investigate the two approaches. Notice that the point plotting method is slow if you need continuous curves but can be smoother if you can leave gaps (see the example of the two lines).

If you want to draw an ellipse then try the following program for a point drawing.

```
  1  HGR2
  2  HCOLOR=3
 10  PI=3.14159
 20  X=100
 30  Y=100
 40  R1=60
 50  R2=20
 60  INC=.08
 70  FOR THETA=0 TO 2*PI STEP INC
 80  HPLOT R1*COS(THETA)+X,
     R2*SIN(THETA)+Y
 90  NEXT THETA
```

Alter the following lines to give a line drawing:

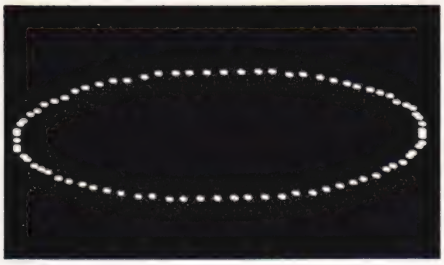
```
 70  FOR THETA=0 TO 2*PI-INC
     STEP INC
 80  HPLOT R1*COS(THETA)+X2,
     R2*SIN(THETA)+Y TO
     R1*COS(THETA+INC)+X,
     R2*SIN(THETA+INC)+Y
 90  NEXT THETA
100  HPLOT TO R1+X,Y
```

The two variables R1 and R2 are the two axes of the ellipse. Just in case you can't imagine why you'd ever need an ellipse then the following program draws a cylinder (baked bean can?) and reveals that a circle on its side is an ellipse! (Note that you need to add the previous program for plotting a line drawing of an ellipse to this one).

```
  1  HGR2
  2  HCOLOR=3
 10  PI=3.14159
 20  INC=.09
 30  X=100
 40  Y=150
 50  R1=60
 60  R2=10
 70  GOSUB 140
 80  X=100
 90  Y=10
100  GOSUB 140
110  HPLOT R1+100,150 TO R1+100,10
120  HPLOT 100-R1,150 TO 100-R1,10
130  END
 :
     INSERT THE LINE DRAWN ELIPSE
     ROUTINE HERE
 :
190  RETURN
```

Shape Tables

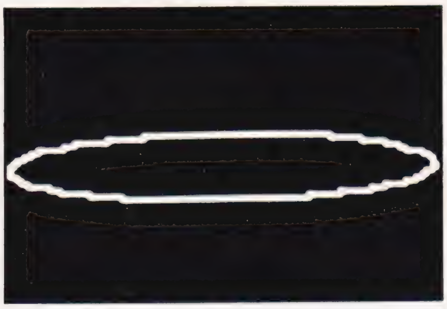
It was mentioned earlier that one of the problems of using Apple



graphics is that standard shapes are not available from the keyboard. This can be overcome by use of a very clever idea — the shape table. Put simply, the shape table is a way of recording the outline of a shape and then plotting it at any point on the screen, any size and in any orientation. So, via a set of shape tables you could make often used shapes as freely available in High-Res graphics as if they were symbols on the keyboard. The only trouble is that shape tables are fairly difficult to use (it would take yet another article to explain them, for example) and my advice to anyone considering using them is to buy a shape table compiler. A shape table compiler is usually a BASIC program that will allow you to draw your fundamental shape on the screen, accepts any corrections and then produces a shape table for it — this makes life very much easier. Shape tables are often used to provide a set of standard characters (ie A-Z and 0-9) so that text can be placed *anywhere* on a graphics screen.

Conclusions

In this fairly rapid look at Apple graphics I have tried to show the sort of things that an Apple can do and how they can be done. I have obviously had to treat some topics very briefly but I hope that I have given the reader sufficient understanding to go on and discover how more advanced graphics are achieved. I say 'discover' for although you can go out and read books on graphics in general, the



Apple is an ideal machine for learning about graphics by experiment and it's fun!

Location	Function
49232 (C050)	Display GRAPHICS
49233 (C051)	Display TEXT
49233 (C052)	Display all TEXT or GRAPHICS
49235 (C053)	Mix TEXT and GRAPHICS *
49236 (C054)	Display Page 1
49237 (C055)	Display Page 2
49238 (C056)	Display Low-Res *
49239 (C057)	Display High-Res *

Table 1. The various display modes and the soft switches which control them. The items marked with an * only function in the graphics mode.

Mode	Page 1	Page 2
Text	1024-2047 (0400-07FF)	2048-3071 (0800-0BFF)
Low-Res	As Text	As Text
High-Res	8192-16383 (2000-3FFF)	16384-24575 (4000-5FFF)

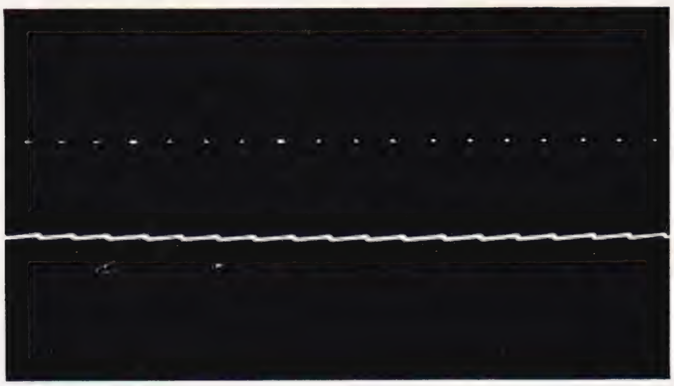
Table 2. The three 'pure' modes and their corresponding screen addressing.

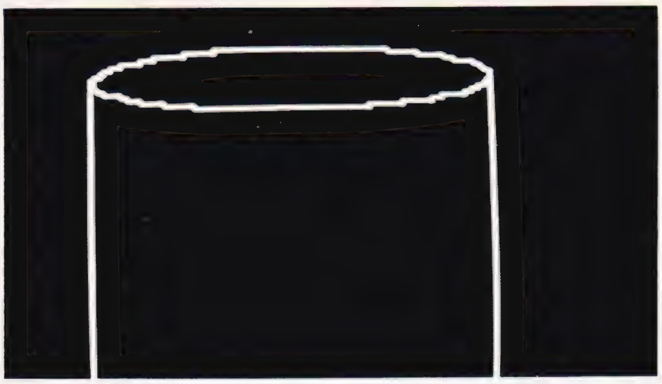
Dec	Hex	Colour
0	0	Black
1	1	Magenta
2	2	Dark Blue
3	3	Purple
4	4	Dark Green
5	5	Grey 1
6	6	Medium Blue
7	7	Light Blue
8	8	Brown
9	9	Orange
10	A	Grey 2
11	B	Pink
12	C	Light Green
13	D	Yellow
14	E	Aquamarine
15	F	White

Table 3. The available colours and their codes for Low-Res graphics.

USING APPLE'S GRAPHICS

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0	@	32	SP	64	AS COLUMN 1 BUT FLASHING	96	AS COLUMN 2 BUT FLASHING	128	@	160		192		224	
1	A	33	!	65		97		129	A	161	!	193		225	
2	B	34	"	66		98		130	B	162	"	194		226	
3	C	35	#	67		99		131	C	163	#	195		227	
4	D	36	$	68		100		132	D	164	$	196		228	
5	E	37	%	69		101		133	E	165	%	197		229	
6	F	38	&	70		102		134	F	166	&	198		230	
7	G	39	'	71		103		135	G	167	'	199		231	
8	H	40	(	72		104		136	H	168	(	200		232	
9	I	41	)	73		105		137	I	169	)	201		233	
10	J	42	*	74		106		138	J	170	*	202		234	
11	K	43	+	75		107		139	K	171	+	203		235	
12	L	44	,	76		108		140	L	172	,	204		236	
13	M	45	–	77		109		141	M	173	–	205		237	
14	N	46	.	78		110		142	N	174	.	206		238	
15	O	47	/	79		111		143	O	175	/	207		239	
16	P	48	0	80		112		144	P	176	0	208		240	
17	Q	49	1	81		113		145	Q	177	1	209		241	
18	R	50	2	82		114		146	R	178	2	210		242	
19	S	51	3	83		115		147	S	179	3	211		243	
20	T	52	4	84		116		148	T	180	4	212		244	
21	U	53	5	85		117		149	U	181	5	213		245	
22	V	54	6	86		118		150	V	182	6	214		246	
23	W	55	7	87		119		151	W	183	7	215		247	
24	X	56	8	88		120		152	X	184	8	216		248	
25	Y	57	9	89		121		153	Y	185	9	217		249	
26	Z	58	:	90		122		154	Z	186	:	218		250	
27	[	59	;	91		123		155	[	187	;	219		251	
28	\	60	<	92		124		156	\	188	<	220		252	
29	]	61	=	93		125		157	]	189	=	221		253	
30	^	62	>	94		126		158	^	190	>	222		254	
31	_	63	?	95		127		159	_	191	?	223		255	





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uter-

Available now- the ZX Printer for only £49.95

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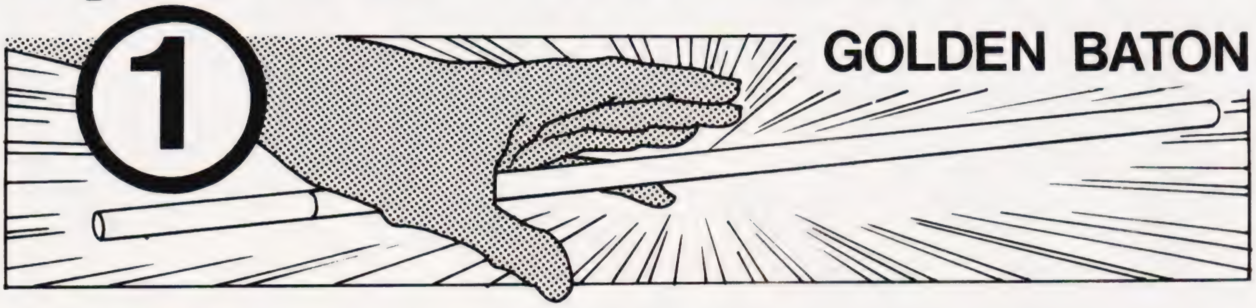

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Dr G J Marshall

If you thought that a PROLOG was something that came at the beginning of books then it's time you read this feature!

PROLOG is a computer language which originated in a university Artificial Intelligence department and its use for most of its early years was within the confines of similar departments. It was originally developed at the university of Aix-Marseilles in France. Since 1972 implementations of the language have been in use there and also at other places, including the Department of Artificial Intelligence at Edinburgh University and the Department of Computing and Control at Imperial College, London. PROLOG (PROgramming in LOGic) is a simple, but powerful computer language which was originally developed to help in automatic theorem proving. The use of formal logic to model human reasoning processes is by no means new, but if computers are to be used in their investigation, then a suitable language helps considerably. PROLOG can be used to good effect in many other areas: automatic data base interrogation, the automation of deductive reasoning or as a language to represent information for natural language processing.

Currently, PROLOG is much more widely available. For example it has been implemented for a range of DEC computers and versions are also available for microcomputers. This wider availability, besides broadening the range of users, has also released the language for use in many application areas other than those originally conceived. Many educational projects, including the use of PROLOG as a tool to teach logic to children, are to be found among the new applications.

Programs In PROLOG

A PROLOG program consists of a number of what are called **clauses**. An example of a clause is:-

```
emerald(X)←  gem(X),green(X).
```

This clause can be read in one of two ways. The arrow '←' can be taken to mean 'if', so that the clause reads 'X is an emerald if X is a gem and X is green'. Note that the comma means 'and': the full stop at the end of the clause is obligatory. Alternatively, the clause can be read as 'to show that X is an emerald, show that X is a gem and that X is green'. The first way of interpreting the clause treats it as a declaration. It is essentially a declaration of the relationships between the properties of X which, in this case, must be true if X is an emerald. The second interpretation treats the clause as a procedure. It describes the procedure that must be followed, in this example, to demonstrate that X is an emerald. You might like to try to give both interpretations to the following clause.

```
microcomputer(X)←computer(X),small(X).
```

There are two variants of the clause. If the part to the right of the arrow is omitted, we obtain a statement that is unconditionally true — there are no 'ifs' giving the conditions under which it is true. With this type of clause (the 'data clause'), data can be entered. For example, when compiling a data base for microcomputers the following clauses might be useful:

```
microcomputer(pet)← .
microcomputer(apple)← .
```

They state, respectively, that the PET is a microcomputer, and that the Apple is a microcomputer.

If the part of a clause to the left of the arrow is omitted, the clause becomes an instruction to find an item satisfying the given conditions. The 'query clause'

```
←microcomputer(X),colourdisplay(X).
```

can be interpreted as 'find an X which is a microcomputer and which has a colour display'. This type of clause activates a PROLOG program, causing it to search for data items satisfying the given conditions. All solutions are given, or if there is no solution an appropriate message is output.

When PROLOG is used on a data base system, data clauses are used to enter the data, ordinary clauses are used to enter relationships between data items, and query clauses are then used to interrogate the data base. Similarly, in automatic theorem proving, axioms are entered in the same way as data; deduction rules, giving the valid ways by which deductions may be made from axioms, are entered as ordinary clauses and then a hypothesis to be tested is entered as a query clause. Any hypothesis which is shown to be true acquires the status of a theorem, and the way in which PROLOG shows it to be true is its proof.

Different versions of PROLOG have different ways of representing the three types of clause, mainly because of the different keyboard character sets that are available with various machines. The following table shows the way each type of clause is written, first as described above, then as in the DEC implementation and lastly as in microPROLOG. MicroPROLOG is described in the first reference given at the end of this article, it was developed at Imperial College, London.

Forming A Data Base

The family tree shown in Fig. 1. provides the data for our example. The information about the family members is to be stored in such a way that queries about the relationships of the various members of the family can be answered automatically. Figure 2 gives the program for entering the data. The family tree is effectively entered in lines 1100 to 2200 by recording who is the father and mother of everyone mentioned in the tree. Although this implicitly gives the sex of all the family members except those who are not parents, it is useful to actually enter the sex of each person, and this is done by lines 100 to 1000. Lines 2700 to 3400 define various family relationships that are true in general. It may be worth interpreting some of these clauses. Line 2700 says that Y is the parent of X if Y is the father of X, while line 2800

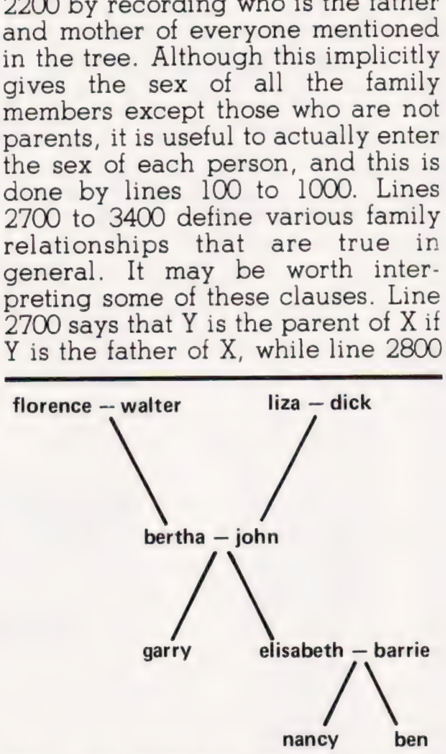


Fig. 1. The family tree that will be used to demonstrate the data base interrogation properties of PROLOG.

says that a mother is a parent in the same way. Taken together, lines 2700 and 2800 assert that Y is the parent of X if Y is the father or the mother of X. Line 3000 can be interpreted as Z is the grandmother of X if Y is the parent of X and Z is the mother of Y. A sibling is defined in line 3200 : it must be admitted that the definition is not precisely in accordance with common usage, but it could, with a little more care, be made to accord. The declaration asserts that X and Y are siblings, if Z is the father of X and Z is the father of Y, and X and Y are not the same. In other words, it says that X and Y are siblings if they have the same father and if they are different people.

Figure 3 shows a dialogue which results from interrogating this data base. The first query clause instructs PROLOG to find X such that X is a sibling of Nancy. The later query clause

```
?- grandparent(garry,X).
```

requires the computer to find all the X such that X is a grandparent of Garry. All four grandparents are duly listed. The final query clause

```
?- uncle(X,Y).
```

```
! ?-sibling(nancy,X).
X=ben;

no
! ?-sibling(garry,X).
X=elisabeth;

no
! ?-uncle(ben,X).
X=garry;

no
! ?-grandparent(garry,X).
X=walter;
X=florence;
X=dick;
X=lisa;

no
! ?-grandparent(nancy,X).
X=john;
X=bertha;

no
! ?-uncle(X,Y).
X=nancy,
Y=garry;

X=ben,
Y=garry;

no
!
```

Fig. 3. Data base interrogation under the program in Fig. 2.

finds all the X and Y such that Y is the uncle of X. PROLOG finds all such pairs and there are only two of them in this instance.

Adding the further clauses

```
descendant(X,Y):- parent(Y,X).
descendant(X,Z):- parent(Y,X),descendant(Y,Z).
```

which give a recursive definition of descendant, queries such as those shown in Fig. 4. can be used to trace all the descendants of any individual.

How Does PROLOG Work?

PROLOG stores all ordinary clauses and data clauses. When it is given a query clause such as

```
?- mother(ben,X).
```

it searches for a value of X such that mother (ben, X) is true. All possible values for X are tried, so that if there is more than one solution, all will be found. Clearly, Ben has only one mother, and she was given in a data clause, so that putting X = elisabeth gives mother (ben, elisabeth), which matches. All other values of X fail to produce a match. When given the query clause

```
?- grandmother(ben,Z).
```

the process is rather more complex. A value of Z must be found such that parent (ben, Y) and mother (Y,Z) are both true. So now PROLOG tries all

```
00100 male(garry).
00200 male(john).
00300 male(walter).
00400 male(dick).
00500 male(ben).
00600 female(elisabeth).
00700 female(bertha).
00800 female(liza).
00900 female(florence).
01000 female(nancy).
01100 father(garry,john).
01200 mother(garry,bertha).
01300 father(john,walter).
01400 mother(john,florence).
01500 father(elisabeth,john).
01600 mother(elisabeth,bertha).
01700 mother(nancy,elisabeth).
01800 father(nancy,barrie).
01900 mother(ben,elisabeth).
02000 father(ben,barrie).
02100 father(bertha,dick).
02200 mother(bertha,liza).
02300
02400
02500
02600
02700 parent(X,Y):-father(X,Y).
02800 parent(X,Y):-mother(X,Y).
02900 grandfather(X,Z):-parent(X,Y),father(Y,Z).
03000 grandmother(X,Z):-parent(X,Y),mother(Y,Z).
03100 grandparent(X,Z):-parent(X,Y),parent(Y,Z).
03200 sibling(X,Y):-father(X,Z),father(Y,Z),X\==Y.
03300 uncle(X,Z):-parent(X,Y),sibling(Y,Z),male(Z).
03400 aunt(X,Z):-parent(X,Y),sibling(Y,Z),female(Z).
03500 :-end.
```

Fig. 2. The PROLOG program.

```
Ordinary clause

ruby(X)←— gem(X),red(X).
ruby(X):- gem(X),red(X).
ruby X if gem X and red X.

Data clause

editor(budgett)←—
editor(budgett).
editor budgett.

Query clause

 ←— microcomputer(X),highresolutiongraphics(X).
?- microcomputer(X),highresolutiongraphics(X).
which ((X) microcomputer X and highresolutiongraphics X).
```

Table 1. The three types of clause as written in standard PROLOG, DEC PROLOG and microPROLOG.

```
! descendant(X,Y):-parent(Y,X).
! descendant(X,Z):-parent(Y,X),descendant(Y,Z).

! descendant(florence,X).
X=john;
X=garry;
X=elizabeth;
X=nancy;
X=ben;

no
! descendant(dick,X).
X=bertha;
X=garry;
X=elisabeth;
X=nancy;
X=ben;

no
!
```

Fig. 4. Interrogating the data base for descendants.

PROGRAMMING LANGUAGES

the pairs of values for Y and Z, and reports any value of Z it finds in a successful matching pair of values for Y and Z.

In this way, PROLOG operates by substituting values for the variables in a query clause, and then seeking to match the resulting clause against a stored data clause to determine if there are values for the variables in the query clause which can make it true. Further, ordinary clauses describe the way in which a problem may be solved by solving each of a set of simpler problems.

Conclusions And Further Reading

The examples given in this article have, hopefully, indicated how successful PROLOG is in providing the facilities for establishing and interrogating a data base. PROLOG has also been a success in the Artificial Intelligence field. In automatic theorem proving it has, on more than one occasion, revealed unexpected proofs of theorems. PROLOG is certainly a very useful language. Its simplicity, together with the fact that it is becoming more readily available for micros, makes it well worth learning; it provides an entry to many interesting areas of activity. It is surely just the language that many people with interests in data bases, logic and AI have been seeking.

An implementation of PROLOG is available for CP/M microcomputers. The microPROLOG language described earlier is described in 'Logic as a computer language for children', by R Ennals, Educational Computing, October 1981, p 67. An account of how an unexpected geometric proof was found by PROLOG is given in 'Solving Problems in PROLOG', by R Welham, Computer Age, August 1980, p 59.

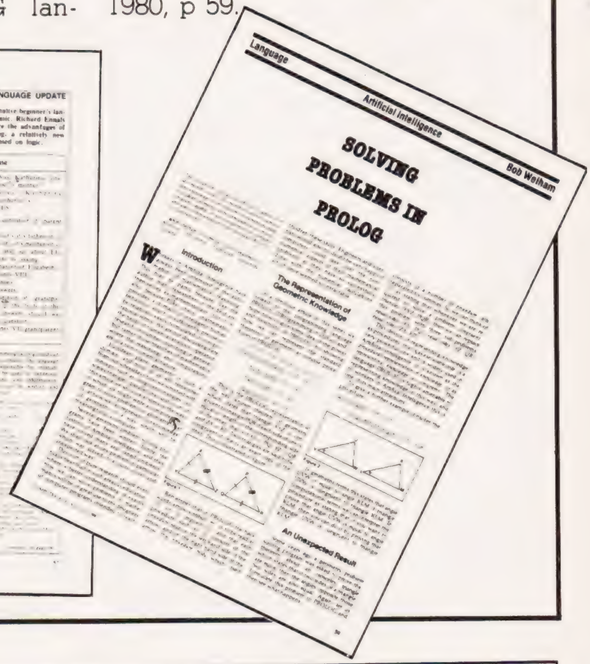

LANGUAGE UPDATE

Logic as a computer language for children

by Richard Ennals
Department of computing
Imperial College, London

Tudor Royal Family Database

Further developments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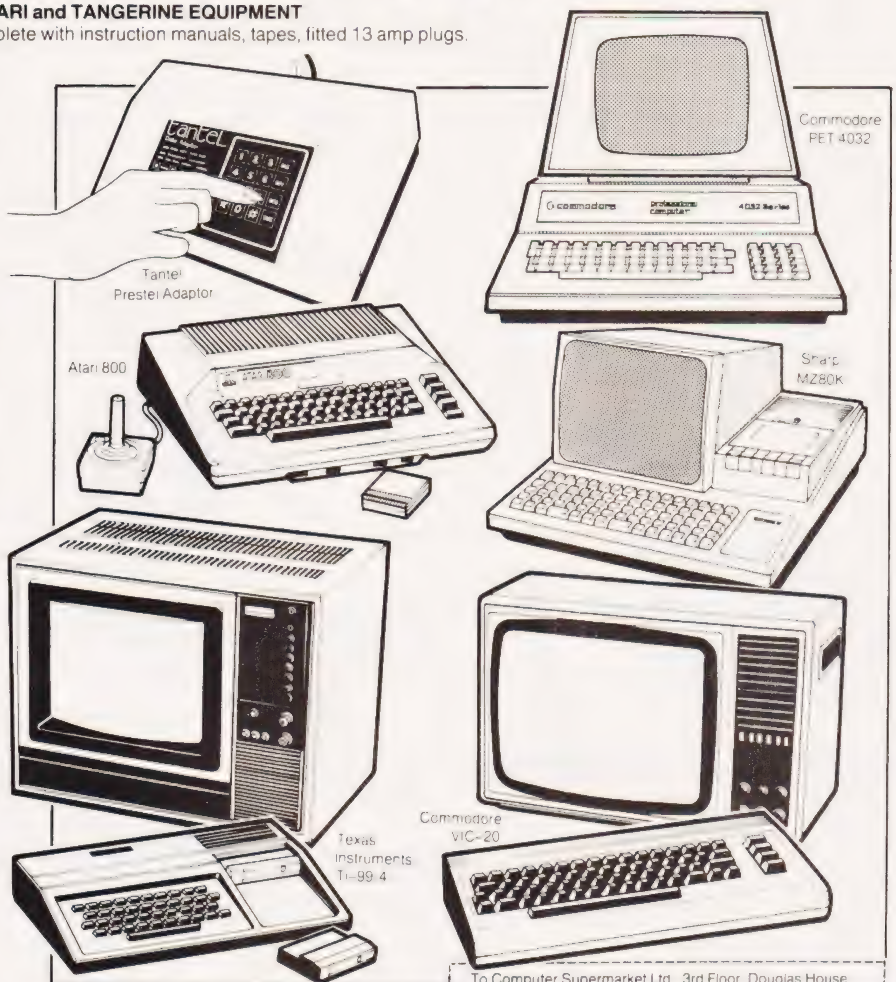

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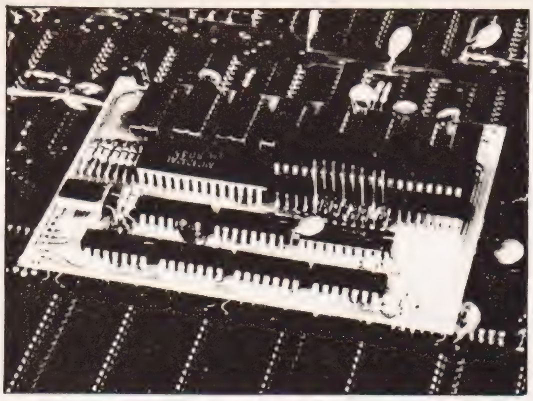

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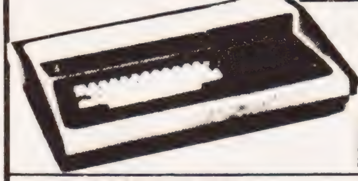

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Tony Edwards

Just what can you do with the rather limited character set offered by the TRS-80, or the Video Genie? Quite a lot really as you'll find out if you read on.

This article is intended to be an overview of graphics programming on the Video Genie and TRS-80 computers and, as such, programmers of all standards should find some parts of it of interest to them. Beginners can start at the beginning and the advanced programmers can skip until they come to more interesting parts. Owners of different models of computers will not find the detailed presentation of great interest, due to the vast differences in the methods of producing graphics displays in different types of computers. Nevertheless, the basic techniques should prove of general interest to all, as similar techniques can usually be employed on other machines and experimentation with all systems is to be encouraged.

The theme of the programs presented here is simple. We shall attempt (not always successfully) to switch on the whole screen: a kind of inverse CLS. This will be attempted using a number of different techniques, and a program is supplied for each method. The programs are consequently very simple, but once the technique has been understood the programs can be varied to produce the required graphics. Finally a more useful program is presented which shows an offbeat use of graphics (especially if you can smuggle it into someone else's machine).

SET And RESET

The simplest and most straightforward way of producing graphics is to use the SET(n,m) statement. After all that is what the thing is provided for. To use this statement to switch on the whole screen, two simple loops are all that are required.

```
10  CLS
20  FOR X%=Ø TO 47
30    FOR Y%=Ø TO 127
40      SET(Y%,X%)
50    NEXT Y%
60  NEXT X%
70  GOTO 70
```

Tried it? Not difficult, but it did take a long time — about 40 seconds. For the beginner a few points are relevant which will be applicable to all programs presented here. The variables are all integer variables (indicated by the % sign). This is good practice when all the values are to be integers (whole numbers) as it saves space and running time. The leading blanks are to give the program a structure, thus making it easier to read and for the same reason I insist on scattering spaces liberally throughout the program. If space is really at a premium (and usually this is not the case) a space deleting program can be used later to remove all unnecessary spaces (and make the program unreadable). The loop in line 70 simply holds things so the READY prompt does not spoil your nice white (green) screen. The SET command and its inverse, the RESET command, are so simple that little more can be said; but before leaving the subject some comment should be made with regard to the 32 character mode. Here the Video Genie and TRS-80 differ considerably — more so than many people expect. Consider:

```
10  CLS
20  PRINT CHR$(23)
30  FOR N%=Ø TO 2Ø
50    SET(N%,N%)
60  NEXT N%
70  PRINT@832,"":REM**THIS MOVES
    CURSOR
80  GOTO 80
```

You may be forgiven if you think this would produce a diagonal line — not so. It does on the Video Genie but not on the TRS-80. The Genie screens all bytes of screen memory at double width if the video cut is set, but the TRS-80 only screens even numbered bytes. Remember there are two pixels per byte when working out which will and will not be screened. The patch for the TRS-80, if you must have that diagonal line, is to insert

```
40  X%=N%+2*FIX(N%/2)
50    SET(X%,N%)
```

Before leaving the subject of CHR$(23), all those Genie owners who cheated by entering the last program first and have not yet found out how to immobilize it should press BREAK to see what a mess CHR$(23) makes to the graphics on a Video Genie. A space is inserted after every symbol printed. To fix this enter CLS which clears the CHR$(23), as well as the screen.

The PRINT@ Statement

Another simple approach is to use the PRINT@ statement.

```
10  CLS
20  FOR N%=Ø TO 1Ø23
30    PRINT@N%,CHR$(191)
40  NEXT N%
50  GOTO 5Ø
```

This sets the screen more speedily than SET, but it still takes a long time (about 10 seconds) and raises a troublesome point. Did you notice the screen jump at the end of the run, and the fact that the screen is not full? Can you understand why? This system control of the cursor can cause trouble in graphics. Consider now that the above does not just produce a set screen but is your masterpiece of graphics (second only to the Mona Lisa) and you want some screened instructions. Add the following:

```
50  PRINT@1Ø,"ARE YOU FINISHED"
60  INPUT A$
70  IF LEFT$(A$,1)="Y" THEN END
    ELSE GOTO 5Ø
```

Now RUN the whole program answering 'NO' to the question as you still want to gaze at your masterpiece. What a mess! The computer never liked your artwork anyway, but all is not lost, everything is possible, the fix is:-

```
52  B$="":REM**NULL STRING
53  CLEAR 2ØØ
54  FOR N%=64 TO 127
55    B$=B$+CHR$(PEEK(1536Ø+N%))
56  NEXT N%
65  PRINT@64,B$
```

All is now fine and your masterpiece is safe from the cursor. The previous program also contains a number of points worth explaining before we go on. Line 30 contains the statement CHR$(191). This is a full six pixel graphic block and is one of a series of numbers from 1 to 255 which can be used to produce various characters, graphics or cursor movements (not all are active). To see the full set run the program:

```
10  FOR A%=1 TO 256
20    PRINT A%,CHR$(A%)
30      FOR B%=Ø TO 5ØØ
40      NEXT B%
50    PRINT:PRINT
60  NEXT A%
```

This program produces a list of all CHR$ codes, and an ERROR which shows what happens if a code higher than 255 is used. The graphic block codes can be calculated as shown in Fig. 1.

The next point of interest is in line 70 where the symbol ',' is used in place of the THEN. A simple abbreviation, but do not expect a re-

USING TANDY'S GRAPHICS

numbering program to notice it. The lines 54 to 56 and 65 are the key to the fix and need some explanation. The symbol on each piece of the screen is held in the memory in locations 15360 to 16383. Consider these as 1024 (2 to the power of 10) little boxes each containing what is on their own little section of the screen. See Fig. 2.

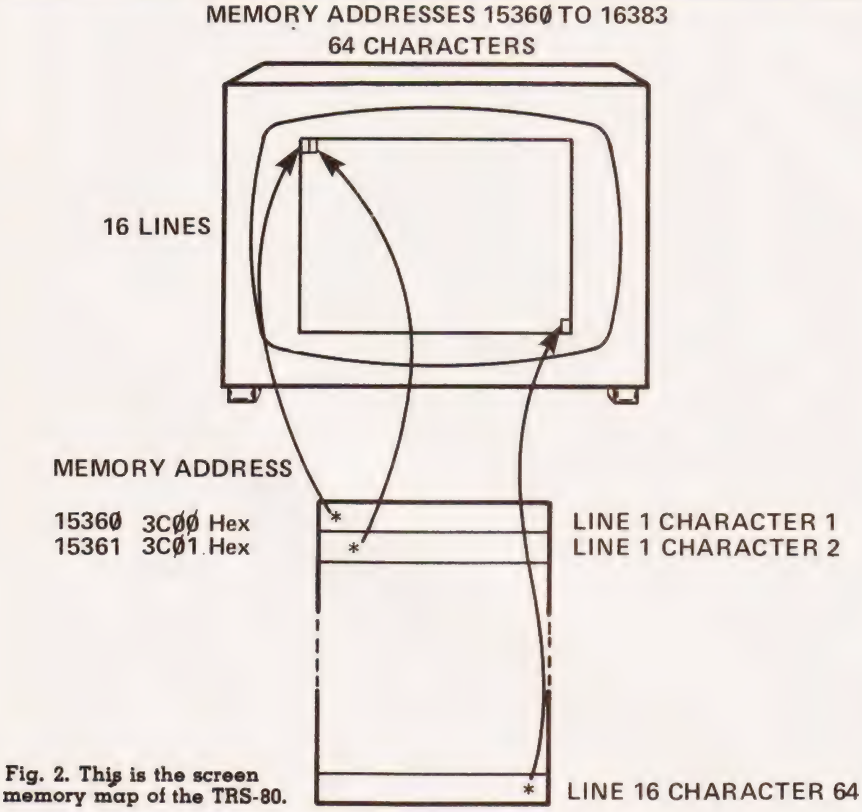

Fig. 2. This is the screen memory map of the TRS-80.

To return to the previous program: when it gets to line 50 most of the boxes contain the solid graphics code 191 and in line 50 some are changed to hold the characters 'ARE YOU FINISHED' and some other things. In line 60 if we are not careful, some more will be changed to 32 (the code for a space). To avoid this in lines 52 to 56 we collect a copy of the second line, spaces 64 to 127, from their memory locations (15360 + 64) to (15360 + 127) and save them as B$. After line 60 they are reprinted on the screen by line 65, and all the damage is repaired.

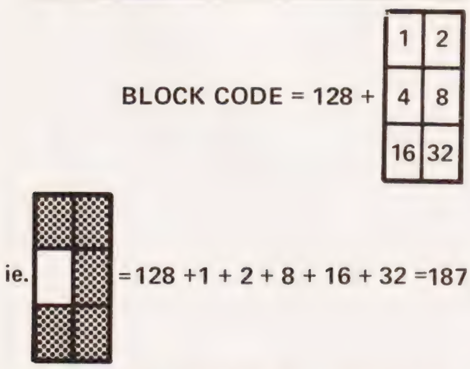

Fig. 1. How to calculate the values of the graphics blocks. Regular readers will spot that this is somewhat similar to our standard for pixel codes.

Fast And Faster Still

Back now to setting the screen, but faster. The TRS-80 Level II manual suggests:

```
10  CLS
20  FOR X%=15360 TO 16383
30    POKE X%,191
40  NEXT X%
50  GOTO 50
```

Not bad, the time taken is about seven seconds. The program uses the screen address as mentioned above and POKEs the graphic block 191 into each memory cell. The POKE instruction places some numbers in a particular location and its reverse PEEK copies the numbers in some particular location, but leaves them undisturbed. This program is quite fast but even faster, and still in BASIC, is:

```
10  CLS
20  CLEAR 259
30  X$=STRING$(255,191)
40  FOR X%=1 TO 4
50    PRINT X$;
60    PRINT CHR$(191);
70  NEXT X%
80  GOTO 80
```

At about one second this is the fastest BASIC program I know to set the screen, and is quite fast enough for most purposes. In either of the two previous examples you can use some other graphic code if you would like a nice pattern.

Machine Code Methods

To produce even faster results we must use machine code. Beginners need not be hesitant to join in, as no damage can be done to your computer by POKEing machine code about. All the essential code is in ROM which you cannot POKE anyway (that is why it is called 'Read Only Memory')! Some vital lines of operation from ROM routines spread into RAM and can be fouled up by POKEing but all 'damage' can be rectified by switching off and on again after 15 seconds.

It is not my intention to give instruction on machine coding here, so you must accept that the following code, in decimal, sets the screen. (After all it is easily proved and contains our old friend the graphic block 191.) 1,16,64,33,0, 60,62,191,119,35,16,252,6,64,13, 32,247,201. This could be used by putting it directly into the memory, but as many readers will not have the necessary program to do this we shall use a BASIC program to put it in a suitable part of the memory.

```
10  CLS
20  X$=CHR$(1)+CHR$(16)+CHR$(64)+..
    ..+CHR$(247)+CHR$(201)
30  X1=PEEK(VARPTR(X$)+1)
40  X2=PEEK(VARPTR(X$)+2)
50  POKE 16526,X1
60  POKE 16527,X2
70  X=USR(0)
80  GOTO 80
```

This program is little more complex than the earlier ones, but should still be easily understood. Line 20 assigns the machine language string to the variable X$. When the program is RUN the computer stores this string in the memory as we

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wanted, but where in the memory? The variable pointer (VARPTR(X$)) identifies the address in the RAM where the variable type is stored and the whereabouts of the actual contents of the string is given by the address stored in the next two memory cells VARPTR(X$) + 1 and VARPTR(X$) + 2. These two parts of the address (the address is too big to fit in one memory cell) are PEEKed and assigned to X1 and X2 by lines 30 and 40. The address is then POKEd into memory cells 16526 and 16527. Now the program proceeds to the dreaded USR command. The form must be X = USR(0), but the X and 0 are (in this case) meaningless symbols. When this statement is reached in the program the computer looks at the address in 16526 and 7 (we just POKEd the X$ address there), jumps to the address stored there and reads the contents as a machine code program. The characters in X$ say 'set the screen' and USR does this very quickly, in significantly less than a second — for most purposes instantaneously.

Something For Nothing

Typing in line 20 was hard work so let us try another way, and just to show I know more than one machine language program we will use another, but it still only sets the screen. The new machine code is:-

33, 0, 48, 17, 0, 60, 1, 0, 4, 237, 176, 201

We will put this into a data statement and POKE it away somewhere with the program below, but first we will enter ?MEM to see how much memory is available and make a note of it

```
10  CLS
20  FOR N%=16512 TO 16523
30    READ A%
40    POKE N%,A%
50  NEXT N%
60  DATA 33,0,48,17,0,60,1,0,4,
    237,176,201
70  NEW
```

Before RUNning the program CSAVE it for later because line 70 will destroy it. After RUNing enter ?MEM again to see how much memory has been used. How much? Yes, that's right, none at all — the machine code program is safely tucked away in protected memory. Something for nothing at last! Now type in and run the following program to use the machine code to set the screen again almost instantaneously.

```
10  CLS
20  POKE 16525,128
30  POKE 16527,64
40  X=USR(0)
50  GOTO 50
```

For the adventurous the USR statement can be replaced by the NAME statement. A bit of a fiddle this, but an interesting area to explore. As a start you should modify the last program, using the EDIT command. I hope you CSAVEd the one before as we now need it again. Two extra machine code steps are required so line 20 should end with 16525 not 16523 and line 60 should have two extra DATA values put in, 229 at the beginning and 225 at the end. Now RUN it and retype the second program but use the memory addresses 16783, and 16784 in lines 20 and 30 and make line 40 NAME. No, this does not produce a SYNTAX ERROR although you may expect it to. Now you can RUN and set the screen. Your machine locked up, but the screen *is* set! The NAME 'statement' does strange things — it alters the HL Register for one (that is why two extra machine code instructions are required to POP and PUSH the HL Register value). It can be mastered, but I leave this to you as an exercise.

String Packing

As a final screen setting manoeuvre we will try POKEing machine code from a DATA statement direct to a STRING statement. This is done by:

```
10  CLS
20  A$="XXXXXXXXXXXX"
30  X1=PEEK(VARPTR(A$)+1)
40  X2=PEEK(VARPTR(A$)+2)
50  X3=X2*256+X1
60  POKE 16526,X1
70  POKE 16527,X2
80  FOR N%=0 TO 11
90    READ D%
100   POKE X3+N%,D%
110 NEXT N%
120 X=USR(0)
130 GOTO 130
140 DATA 33,0,48,17,0,60,1,0,4,
    237,176,201
```

If you have followed the previous examples, the workings of this program should be clear. That is if you only RUN it once. RUN it twice and you are in trouble. A Syntax Error in a non-existent line of all things. All will be revealed if you list line 20. This program changes itself and to RUN it again we must re-assign 12 Xs to A$.

Does the above program give you some ideas? If not, how about adding to your graphics masterpiece the lines:-

```
1000  A$="GRAPHICS BY NO ONE IN
      PARTICULAR"
1010  PRINT A$
```

Then, before reaching line 1000, POKE your name in place of 'NO ONE IN PARTICULAR'. Then after line 1010 POKE 'NO ONE IN PARTICULAR' back. If you also immobilise the BREAK key (with POKE 16396,23) it will give some worries to those who wish to claim authorship for your graphics. This is not as easy as it seems, but worth the effort. I again leave it as an exercise.

Now that you have worked so hard to set the screen, and have had your appetite whetted for some fun, type in the sequence of commands 'SYSTEM' ; '/0' ; '32688' to protect a little high memory, then type in and RUN the following program (CSAVE it first because of line 190). That READY prompt is gone for ever, TRS-80 owners may change the program if it upsets them.

```
10  CLEAR 500
20  A$=CHR$(128)+CHR$(157)+
    CHR$(156)+CHR$(149)+CHR$(13)+
    CHR$(176)+CHR$(179)+CHR$(183)+
    CHR$(177)+CHR$(144)+CHR$(13)+
    CHR$(133)+CHR$(191)+CHR$(175)+
    CHR$(149)+CHR$(133)+CHR$(13)+
    CHR$(180)+CHR$(191)+CHR$(170)+
    CHR$(181)+CHR$(148)
30  B$=CHR$(13)
40  C$="GENIE IS AT YOUR SERVICE-
    WAITING"
50  A$=A$+B$+C$:REM**LEN(A$)<63
60  FOR K=32688 TO 32703
70    READ D
80    POKE K,D
90  NEXT K
100 DATA 205,248,1,205,249,32,33,
    192,127,205,167,265,167,40,225,
    195,43,26
110 K=32704
120 FOR J=1 TO LEN(A$)
130   POKE K,ASC(MID$(CA$,J,1))
140   K=K+1
150 NEXT J
160 POKE K,13:POKE K+1,0
170 K=16812
180 POKE K,195:POKE K+1,176:POKE
    K+2,127
190 NEW
```

Next time you are demonstrating a program on a friend's machine add the above (remember to protect some memory for it) and he will be stuck with a new 'READY' prompt until he switches off. If you have no friends, only enemies, you may like to modify the program before forcing it on them. It is easy to do. A$ contains the graphics, B$ is a line feed and C$ is the message. If you use more than 62 characters you will have to change lines 60 and 110 and protect more memory.

As a parting 'shot'; if you have the program in high memory and get so frustrated with the machine that you could kill it, just shoot graphics blocks (our old friend 191) into the 'protected' memory above 32688 with the POKE instruction and kill the Genie, because that is where it lives. It will not help you to be a better programmer, but it may make you feel better.

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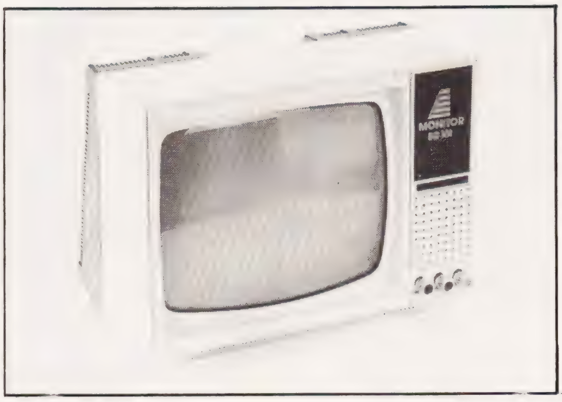

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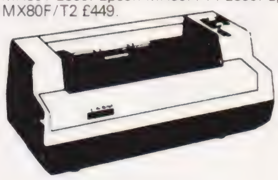

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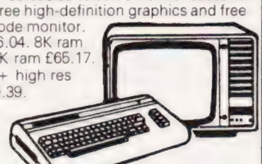

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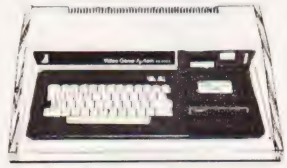

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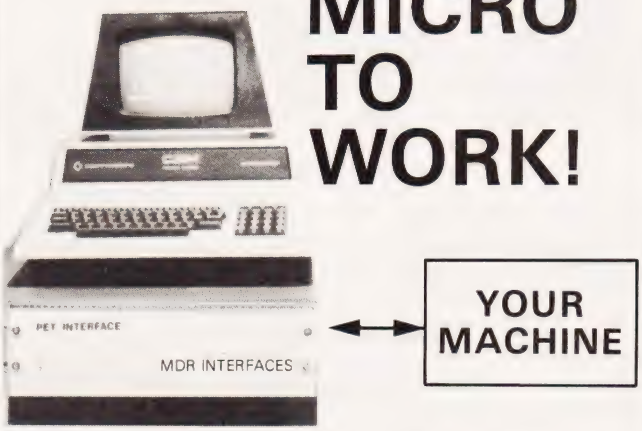

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Henry Budgett

The results of two years work become public property this month with the first showing of 'The Computer Programme'. This is the story of why and how it happened.

Finding a way of starting this article about the BBC's new computer literacy series was proving something of a problem. However, during a conversation with the series producer, Paul Kriwaczek, I asked him to explain just ***what*** the series was about.

After a moment's pause he said, and I quote:

"Last year on BBC Television there was a series called 'Tinker, Tailor, Soldier, Spy'. In episode one of this series, we meet a character called Ricky Tarr and he says the following immortal line.

'Gentlemen, I'm going to tell you a story and if the story I'm going to tell you is true — and I believe it is — you boys are going to need a whole new organisation.' That's what the series is about."

On reflection, that ***is*** exactly what the series is about. Our society is about to go through a period of technological change totally unparallelled in history; a change that will force us to develop a whole new way of life.

The aim of the 10 programmes is to present the basic concepts of microcomputers in simple terms and show the effects that the application of these concepts will have on our lives.

How It All Began

To unearth the actual inception of the series we must go back to the classic Horizon series which was broadcast during 1978 and which included 'Goodbye Gutenburg' and 'The Chips Are Down'. This was the point when the general public started to become aware of the microprocessor and some of its implications.

The following year, 1979, saw the first attempt by the BBC to produce a series on the micro 'revolution' — 'The Silicon Factor'. This three-part series was proposed by Robert Albury and was jointly researched with David Allen. The series was an undoubted success but for one small point; it left more questions than answers! The obvious solution was to make another series which would bring the subject up to date and answer all those questions.

Even while the series was being filmed in late 1979, a certain Paul Kriwaczek, (whose name may be somewhat familiar to readers of Computing Today), proposed a series of ten programmes to fill this gap. The series was to present an information package aimed at the educational market and at that time the main theme was to be programming.

This idea led to a serious problem. If one was to introduce programming, one had to standardise using a specific computer; yet it would be impossible for the BBC to endorse a commercially available product. However, even as the central theme of the programmes began to divert from programming, a policy decision was taken — in conjunction with the Department of Industry — to produce a BBC Micro.

Because of the direct involvement between Newbury and the DOI, the system chosen was the NewBrain, a hand-held system which appeared to have everything possible going for it. The origins of the computer were somewhat clouded as many of its original concepts belonged to work done at Sinclair Research before the entire project and its development team were shipped off to Newbury's Berkshire establishment.

By now it had become fairly obvious that the secrets were out and so Newbury launched the system on to the market. The problem here was that they didn't actually have a completed model! The public woke up to the fact that the BBC were going to produce a series on micros; a computer was going to be offered for sale and tens of thousands of words were promptly written about how they should or shouldn't do it. The sad thing is that by this time, mid-1980, it had already been decided that the programmes would ***not*** be based around teaching programming and that this would be handled by the National Extension College who would run a correspondence course in BASIC programming using the NewBrain as the standard computer.

The reason why the central theme of the series was changed is simple. As Paul Kriwaczek learnt more about micros in general (he owns and programs a NASCOM 2) he realised that programmers actually understand very little about the fundamentals of the computer — they simply don't need to. This understanding of the fundamentals was what he wanted the programmes to be about — therefore, the series could ***not*** be based on programming — QED!

The Making Of The Pilot

By late 1980 it had become obvious that some kind of piloting exercise was needed and in the incredibly short period of three weeks the programme was written and filmed. Owing to heavy studio commitment in London, the actual filming took place in the BBC's Oxford Road studios in Manchester late in December 1980. At that time the cast consisted of Chris Serle from

The BBC Computer surrounded by its various extras. The disc drive is, in fact, a dummy!

From left to right we have Chris Serle, Ian Trackman (Software Consultant) and Ian McNaught-Davis. Oh yes, the robot arm is the one produced by Colne and recently featured in ETI.

'That's Life', Jonathan Baldachin from 'Little Genius' (who acted as the expert) and Serena Macbeth, who filled the role of a roving reporter.

Despite at least one apparent 'review' of this pilot it was ***never*** shown publicly; it was only screened for sample audiences. The results of these piloting exercises produced a number of important pointers as to what the viewing public really wanted.

Among the findings (many of which were somewhat predictable), the strongest impression gained was that the public really do want to learn about micros, with the proviso that the material should be application-oriented; 'Tomorrow's World with knobs on' was one expression which sums up the results rather neatly! The other overwhelming reaction was that the general public does not like the idea of the BBC actually selling something, be it book, video tape or computer!

At this point it became obvious that the planned series could only cater for a general audience — it dare not specialise. This backed up still further the argument for not including any serious discussion on programming in the series; to show a computer program of any kind in the allotted time would require an example so trivial that it would not then be worth showing — Catch 22!

The intention was to have the series ready for transmission in the Autumn of 1981, but continued difficulties with the production of the NewBrain led to the whole concept of a computer being reviewed. During the Spring of 1981 a number of computers were looked at as an alternative to the NewBrain and it was eventually decided to move the whole project to Acorn Computers.

If it were not ironic enough that the project should be moved back to Cambridge, the final twist was that Acorn were an offshoot of Science of Cambridge, Sinclair's original company! Two other interesting things happened during this period of frantic activity. The first was that Clive Sinclair unveiled his — as yet unannounced — ZX81 system and the second was that, five minutes after the decision was made to move the computer to Acorn and start afresh, Newbury arrived at the BBC with a working prototype!

A Double Bill

It should be fairly obvious by now that the BBC are really running two projects simultaneously; 'The Computer Programme' and 'The BBC Computer'. This is not to say that the BBC Micro will not appear from time to time in the series. Indeed it will be used to demonstrate some of the fundamental principles that are being discussed, but ***only*** if it is appropriate.

The BBC Micro is being supported by a number of products including the NEC Course, a number of programs and a book. The latter product has been co-written by Robin Bradbeer, Peter Laurie and Peter de Bono — all well known for their various activities in the computer field.

Among the software products available will be a suite of programs called the 'Welcome Package' which gives users useful routines such as a Telephone Directory, Sorting, etc; some games and a number of examples of the graphics functions of the system. After spending the best part of a day playing with a selection of the programs from this package, I must confess to being pleasantly surprised by their quality. I hope the team responsible for this maintain their standards for the commercial programs.

The Ten Programmes

In the light of experience gained from making the pilot programmes, two changes have been made to the team of presenters. The show still remains in the hands of Chris Serle who acts as the link-man. He represents the viewer and seeks answers to the fundamental questions about computers and their effect on our lives.

The place of 'resident expert' has been taken by Ian McNaught-Davis, well known in the professional computer market and no stranger to the small screen.

Gill Nevill is now cast in the role of 'roving reporter' and her background includes the editing of the Central Office of Information's syndicated features on science. The team that will be seen on-screen is backed up by a number of specialists who make appearances from time to time — Rex Malik being among the names that readers may recognise.

Before I break the 10 programmes down into their component parts, it is worth explaining the way in which each has been put together. Each programme must be capable of being watched and understood in its own right (audience research has proved that only a small percentage of people who watch the first episode of a series actually watch all the others). In order to ensure that each programme stands up individually, the material included was confined to just one central theme — after all with only 25 minutes to get the idea across, that's about the most you could expect! Each of the programmes also has its own Technical Consultant — a qualified individual from the world of micros — who has co-ordinated the overall material put into that 25 minutes. This has then been produced as either a filmed location report or as a worked studio set-piece with the relevant presenters.

The overall effect is that if a viewer watches just one of the 10 programmes, he or she will get a 'snapshot' of the technology and its applications. To gain an overall understanding of the subject one would have to watch all 10 episodes.

THE SERIES

THE COMPUTER PROGRAMME 1

First transmission:
Monday January 11th BBC2 15:05
Second showing:
Sunday February 14th BBC1 10:10
Repeated:
Monday March 22nd BBC1 23:35*
*(This slot is, as yet, unconfirmed)

Opening with a scene shot at dawn at Stonehenge and closing with an airliner climbing into the sunset, the programme carries the subtitle "Don't expect the computer revolution to happen tomorrow, it's going on all around you".

This programme is intended to set the scene for the following eight episodes — programme ten then tying up the various ideas. At the time of writing, the studio scenes have been filmed, but I have only seen the location material. However, in the words of the producer "It's going to be a hard act to follow"!

THE COMPUTER PROGRAMME 2

First transmission:
Monday January 18th BBC2 15:05
Second showing:
Sunday February 21st BBC1 10:10
Repeated:
Monday March 29th BBC1 23:35

Originally entitled 'Bits and Bytes', the direction of this episode has been changed to include the concept of the stored program — an idea fundamental to the understanding of computers. Among the scenes already 'in the can' are the Vauxhall assembly plant, a sequence showing weaving on a Jaquard loom and a discussion of Hollerith's punched card which is conducted in a genuine 1930s office.

THE COMPUTER PROGRAMME 3

First transmission:
Monday January 25th BBC2 15:05
Second showing:
Sunday February 28th BBC1 10:10
Repeated:
Monday April 5th BBC1 23:35

The central theme of this programme is computer languages; ***not*** assembler, Pascal or FORTRAN, but the concept of what a computer language is.

Computer language is really a matter of sending formal little notes to the CPU and waiting for it to obey them. A simplified view perhaps, but one which is nearer the truth than most. The user never really forgets the fact that he or she is actually trying to communicate with a machine, and not another human.

Just in case you thought that we had forgotten languages altogether, this programme will include a demonstration of the BBC Micro and BASIC!

THE COMPUTER PROGRAMME 4

First transmission:
Monday February 1st BBC2 15:05
Second showing:
Sunday March 7th BBC1 10:10
Repeated:
Monday April 12th BBC1 23:35

By this stage we will have seen that the computer contains a number of separate sections and that these are controlled by a program. The question now is 'how does the computer store information?' Programme 4 is fundamentally about information storage and processing.

The programme starts off at the British Library with Ian McNaught-Davis searching their data base system for book references, a typical example of how microcomputers have become integrated into even the most mundane functions. Later in the episode, we will see a Commodore PET being used to organise the catering department of a small hospital — another example of a small computer performing a very powerful function.

On the data processing side, we hope that you'll see a 'bubblesort' being performed on (of all unlikely things) a set of baked bean cans! It might sound funny, but the process itself is one of the most basic requisites of information retrieval and manipulation.

THE COMPUTER PROGRAMME 5

First transmission:
Monday February 8th BBC2 15:05
Second showing:
Sunday March 14th BBC1 10:10
Repeated:
Monday April 19th BBC1 23:35

In many ways this is an extension of the ideas introduced in the previous programme when we saw how one computer could be used to store large quantities of information. In this episode we discover what would happen if we connected a large number of computers together, each of which has a large store of data.

The heart of this episode is Communication; not between humans, but between computers. The sort of communication which allows us to perform Electronic Fund Transfers, Electronic Mail and a host of other advanced operations.

One of the projected sequences is a live, round-the-world link using the ARPANET service — phone freaking with a difference.

THE COMPUTER PROGRAMME 6

First transmission:
Monday February 15th BBC2 15:05
Second showing:
Sunday March 21st BBC1 10:10
Repeated:
Monday April 26th BBC1 23:35

This programme is effectively the

last of the five that are concerned with the basic concepts. It covers the fields of non-textual input and output, ideas fundamental to the use of computers for control and similar functions. The two main areas that the programme is going to cover are graphics and sound, the spectacular side of micros.

Among the featured examples will be the Alpha Centauri synthesiser system and an amusing sequence featuring a sweater being unravelled showing that, despite the apparent loss of order, the original pattern still remains.

THE COMPUTER PROGRAMME 7

First transmission:
Monday February 22nd BBC2 15:05
Second showing:
Sunday March 28th BBC1 10:10
Repeated:
Monday May 3rd BBC1 23:35

We are now into the second section of the series which concentrates on the uses to which the microcomputer can be put. The first application to be examined is the subject of modelling and simulation.

Among the sequences already filmed are ones showing the latest in-flight simulators and the optimisation of ship performance using a computer. It is more than likely that the odd game will make an appearance in this programme. Far from being trivial examples of the misuse of micros, they often represent the only way of demonstrating this complex subject.

THE COMPUTER PROGRAMME 8

First transmission:
Monday March 1st BBC2 15:05
Second showing:
Sunday April 4th BBC1 10:10
Repeated:
Monday May 10th BBC1 23:35

One of the hottest areas in computer research at the present time is that of Artificial Intelligence and its allied subject, the Expert System. It turns out — and this will be shown during the course of the programme — that what you would pay a human 'expert' vast sums of money to do — medical diagnosis, for example — a computer can mimic quite simply. The converse is also true; functions so trivial that we don't even have to think about them (the observation and interpretation of a scene for example), — we don't yet know where to begin as far as computerisation is concerned.

The central theme of this program is nicely summed up by a quote from Rex Malik. "We can teach a computer to produce Boeuf Bourguignon quite easily and it will make that dish for us time and time again. But, how can it tell whether it has made a good one or not?"

THE COMPUTER PROGRAMME 9

First transmission:
Monday March 8th BBC2 15:05
Second showing:
Sunday April 11th BBC1 10:10
Repeated:
Monday May 17th BBC1 23:35

Programme nine is all about the unsung 'heroes' of the computer revolution·the micros that are being built into your washing machine, cooker, or even your toaster. They constitute the *real* micro revolution and, as we said in programme one, they are already doing their thing.

Filmed material will hopefully include a ride on the latest micro-controlled Honda motorcycle and a trip round your friendly local sewage farm!

THE COMPUTER PROGRAMME 10

First transmission:
Monday March 15th BBC2 15:05
Second showing:
Sunday April 18th BBC1 10:10
Repeated:
Monday May 24th BBC1 23:35

This is the final episode in which all the themes so far presented come together and the possibilities tomorrow has to offer are inspected. Much of the location material has been filmed in America and one of the more interesting quotes comes from Charlie Lecht, President of Applied Computer Techniques Corporation, who — among other things — wrote the software for the F16 fighter. He says, "There's nothing, but nothing, human beings can do that a machine can't do better, quicker and cheaper. And they will do it."

The other staggering sequence features Earl Joseph, the man Sperry Univac pay to tell them what's going to be happening in ten years time, holding up a silicon wafer containing some thirty processors (today's technology) and stating what could be done with the power that is available now.

Another group shot of the personnel involved. In this one they are joined by the Producer, Paul Kriwaczek.

GOING FORTH

D S Peckett

Part two of our programming series delves into the way you define new words for your language together with comparative testing.

Last month we had a first look at FORTH. The language turned out to be very different from BASIC and to have many advantages, such as being much faster in operation. On the other hand, it became clear that you can really only appreciate FORTH if you already know something about computer programming, since its effective use does demand more knowledge of a computer's hardware than some other languages do.

In the first article, we concentrated on finding out just what FORTH is, and did not go into any great depth on how to use the language effectively. All the operations which we performed were in the Immediate mode, we did not even try to write any programs. This month we will go on to have a closer look at the use of FORTH by studying how new words are defined. We will also look at the use of variables and constants, the way that conditional operators work and some of the language's looping structures.

If you missed the first part of this series, you should note the following conventions that we will be using:

a. Any FORTH function, be it an operator, 'subroutine' identifier, program control structure, etc is called a 'word'.
b. Normally, FORTH words will be obvious from the context but, whenever there might be any confusion, they will be enclosed in double quotes. The quotes are not part of the word.
c. In the sections which show a dialogue with the computer, the computer's output is underlined.

Creating FORTH Words

One of the most remarkable features of FORTH is its ability to be user-extended by the addition of new words. A typical, newly-delivered, FORTH system contains about 100-150 usable words. Writing programs, however, depends heavily on using these words to define new words, which can be used to define yet more words, etcetera!

Eventually, one hopes, the whole function of the program will be represented by a single word. Enter it, and the FORTH interpreter dips up and down through the dictionary, executing the hierarchy of words that went into defining the program.

So, how do we define a new word? By using the DEFINING WORDS ":" and ";" — the form of a new word definition is:

```
: <wordname> <action> ;
```

For example, it might be that we often have to calculate the cube of the number on top of the stack. It is easy to define a new word to do the job:

```
: CUBE   DUP DUP * * ;  OK
```

Having done that, we can calculate and print a cube whenever we want, eg:

```
4 CUBE .  64 OK
```

This is identical to:

```
4 DUP DUP * * .  64 OK
```

The definition of CUBE above is called, for obvious reasons, a 'colon definition'. As in any FORTH statement, it is essential to leave at least one space between each word, and it is conventional to leave at least three after the word name in program listings in order to make them easier to follow.

Since a word can be any combination of ASCII characters, apart from spaces, it is possible to redefine existing FORTH words via colon definitions — the words take on the meaning of the last definition. If we were that daft, we could redefine, say, the 'PRINT' word "." to have the meaning of CUBE. Some, but not all, FORTH systems warn you if you try to re-define an existing word.

Once a word like CUBE has been defined, it has exactly the same status as any other word, and can be used in new definitions. For example, we might want to regularly compute and print $(3x^3 + 2x - 7)$, where x can be entered from the keyboard. Define another word:

```
: CUBIC
DUP CUBE 3 * SWAP 2 * + 7 - . ;
```

and the job is done. Fig. 1 shows the action of CUBIC during:

```
1Ø CUBIC   3Ø13 OK
```

You'll realise, I hope, that we could have defined CUBIC without CUBE by merely inserting the CUBE code into the CUBIC definition. In fact, a colon definition could be up to 1024 characters (ie one screen) long.

Defining Good Practice

It is good FORTH programming practice, however, to use lots of short definitions — a definition should rarely need to be more than two to three lines long. By breaking the code up into lots of small blocks, it is much easier to debug a program, since each new word can, and should, be tested in isolation, using FORTH's immediate mode. In fact, it is this ease of testing compiled program segments that helps to make FORTH program development remarkably quick and painless. The short definition approach has the additional benefit of making it much easier to read a program.

A word can be defined in either the immediate mode, as we have done here, or as part of a program. Either way, it has the same status, and can be used afterwards in either immediate or program modes.

Every time that you define a new word, extra code is added to the FORTH dictionary. Eventually, the dictionary could grow high enough

STACK	24ØØØ	5Ø	2 5Ø	1ØØ	
	SCORE	@	2	*	.

Fig. 2. Fetching a variable's value with the "@" function.

STACK	1Ø	1Ø 1Ø	1ØØØ 1Ø	3 1ØØØ 1Ø	3ØØØ 1Ø	1Ø 3ØØØ	2 1Ø 3ØØØ	2Ø 3ØØØ	3Ø2Ø	7 3Ø2Ø	3Ø13	
	1Ø	DUP	CUBE	3	*	SWAP	2	*	+	7	−	.

Fig. 1. CUBIC's operation as seen on the stack.

in memory to meet the stack coming down, when the result would be a crashed system.

For this reason, and particularly when you are developing new code, it can be useful to erase all your work from the dictionary, and reset the system pointers. The job is done by:

```
FORGET <word>
```

This erases <word>, and all the words defined after it, from the dictionary. The normal convention is to start a FORTH session with the dummy definition:

```
: TASK ;  OK
```

The work can then be erased by FORGET TASK. FORTH programs often start with a TASK definition, and finish with a FORGET TASK to free the system for other work.

You will soon know if you try to use a word that has been FORGOTten, because you will get an error message of the form:

```
CUBE  CUBE?
```

When you write FORTH programs, as opposed to lines of immediate code, the colon definitions and so on are written directly into SCREENs, the basic program storage units. FORTH incorporates a line-oriented editor to make this job easy. MMSFORTH also has a powerful screen-oriented editor for program construction and modification.

Whichever form of editor is used, once a system has been created, or loaded from tape or disc, it can either be edited, or else the LOAD word can be used to compile a screen, or series of screens. The compilation puts all the colon definitions into the dictionary, and immediately executes any non-definition lines. Thus, if the screen(s) contains a program end with the program's name, the program is compiled and run in one operation.

Variables And Constants

So far, we have only looked at ways of putting numbers onto the stack and manipulating them once they are there. As far as possible, FORTH programs should use only the stack, since it is the best way of exploiting the speed of the language, but a few well-chosen variable names can also help to make the program easier to follow. The use of variables and constants can also help to avoid making the stack too complicated — if you are juggling lots of different numbers on the stack, things can get a little hairy — by providing somewhere to keep information when it is not being manipulated.

Like Pascal, and unlike BASIC, variables and constants must be defined before they are used for the first time; they can, however, be defined at any point in a program. Their definitions use the forms:

```
12 CONSTANT DOZEN  OK
 Ø VARIABLE SCORE  OK
```

The number at the beginning of the definition sets the constant value, or the initial value of the variable (the value it has at the moment that it is defined). "CONSTANT" and "VARIABLE" are Defining Words that tell the compiler just what to do while, in the usual back-to-front way of FORTH, the parameter names come last.

You should always choose the name of the constant or variable to have real meaning and to help you to understand the program. There is no need to cut down on characters to save RAM because FORTH is compiled and the name of every word is saved in the same way, no matter how many characters it has. It is worth noting here that the way that the system stores word names can cause problems.

Every FORTH word is identified internally by two items of data — its first three characters and the total number of characters in the name. Thus '1TOTAL' and '2TOTAL' are different, but the system cannot distinguish between 'TOTAL1' and 'TOTAL2' — it will always use the one that was defined last. Alternatively, 'TOTAL1' and 'TOTAL1*' are different (but needlessly confusing). The name of a word can use any character except a space.

Having digressed, let's return to the subject of constants and variables. How do we use them? Constants are easy; whenever its name is used, then the value of the constant goes straight on to the top of the stack. Thus:

```
DOZEN .  12 OK
```

The action of variables is, however, rather more complicated. Whenever a variable name is used, then FORTH actually puts the variable's address on top of the stack. Remember also that data is normally stored in two-byte words; the address that is put on the stack will thus be that of the first of the pair of bytes. In a Z80-based system like MMSFORTH, that byte will hold the eight least-significant bits of the data, but you do not necessarily have to worry about that sort of detail. Suppose that the system compiled 'SCORE' to lie at addresses 24000 and 24001. Then:

```
SCORE .  24ØØØ OK
```

Obviously, the address at which a variable is stored is not a great deal of immediate use and so FORTH provides ways of manipulating the data.

"!" (pronounced 'store') puts the value that is second on the stack (2OS) into the address represented by the value that is on top of the stack (TOS). The two numbers are erased from the stack:

```
5Ø SCORE !  OK
```

leaves SCORE set to 50.

"?" treats the number (two bytes remember) that is TOS as an address and prints the two-byte number held at that address. Thus

```
SCORE ?  5Ø OK
```

The address is erased from the stack, although the value that is held in the variable is not altered.

Finally, "@" (pronounced 'fetch') treats the number on the top of the stack as an address, and replaces it with the number held at that address. For example:

```
SCORE @ 2 * .  1ØØ OK
```
(see Fig. 2)

To bring all these points together, suppose that the variable SCORE (any variable is also a FORTH word) must be incremented by 1, and the new value both printed and saved:

```
SCORE DUP @ 1 + DUP . SWAP !  51 OK
```

Figure 3 shows what is happening — note that the "." does not end the processing, which carries right on as soon as the number has been printed.

As another example of the use of variables, take the standard quadratic formula:

$ax^2 + bx + c$

If a, b and c are held as variables A, B and C, how do we calculate this expression in FORTH? Assume that x is already on the stack; we can then use:

```
DUP A @ * B @ + * C @ +  OK
```

This actually calculates the expression as ((A*X+B)*X+C) — Fig. 4. shows what happens.

A warning from bitter experience — I must stress that using a variable's name only puts its address on the stack (unlike BASIC, Pascal, FORTRAN et al) — forget that and you will get some very strange results. It is also worth remembering that the operators such as "!" and "@" aren't limited to use with variables — they will take whatever is on top of the stack and treat it as an address. This can be useful, since it gives you access to anywhere in memory. For instance, a TRS-80 keeps a pointer to the top of memory at addresses 16561 and 16562; you can adjust it to whatever you want from FORTH by:

```
<nnnn> 16561 !  OK
```

where <nnnn> represents whatever number you choose. (Actually, you will probably crash the system by altering its pointers like this, but that's another story.) If you like, you can think of "!" and "@" as being equivalent to a NASCOM's 'DOKE' and 'DEEK' respectively.

Sometimes, of course, you may only wish to move a single byte and not the two-byte words we have met so far. FORTH meets this need with "C!", "C@" and "C?". The first one puts the lower byte of the data that is 2OS into the address at TOS, while the second and third respectively fetch and print the single byte pointed to by the TOS address. If "C@" is used to fetch a byte, it is actually placed on the stack as the lower byte of a two-byte word in which the higher byte is set to zero. These character-oriented words are equivalent to BASIC's 'POKE' and 'PEEK' and could be used, for example, to set a TRS-80's automatic printer Form/Feed to 80 lines/page:

```
80 16424 C !  OK
```

In practice, though, they are of most use in string handling, where each character is stored in a single byte.

Conditional Operators In FORTH

Like any other computer language, FORTH has a number of conditional operators. They all operate on the top one or two items in the stack, and replace the tested item(s) with a single condition flag. The convention is that if the result of the test is TRUE, then the TOS contains '1'; if it is FALSE, then TOS is zero. In practice, most, if not all, FORTHs will interpret any non-zero number as TRUE.

The standard operators are:

"<". This compares the top two items on the stack and sets TRUE if the TOS is larger than the 2OS. Figure 5 shows the action of:

```
5 6 7 8 <
```

">". This is the opposite of "<", setting TRUE if the TOS is smaller than the 2OS. For example, Fig. 6. describes:

```
5 6 7 8 >
```

"=". Not surprisingly this sets TRUE if the top two items are equal.

"0=". This word operates on the TOS only, replacing it with '1' if it is equal to zero. Effectively, it has the colon definition:

```
: 0=  0 = ;
```

"0<". This is the last standard conditional operator. It gives the result TRUE if the TOS is negative.

These are the five basic operators, but it is obviously easy to define others if you need them. You might want:

```
    : 0>  0 > ;
or: : <>  = 0 = ;
```

If the "< >" definition is unclear, look at Fig. 7. for

```
5 6 7 8 <>
```

The "0=" inverts the TRUE/FALSE condition on TOS. Those of you who have met FORTH before will recognize that there are a number of other ways of doing this, but they use words which we have not yet seen.

Branches And Loops In FORTH

Any realistic computer program makes use of conditional, branching, structures, and of iterative (looping) procedures. In addition, some languages, such as BASIC, force the use of unconditional jumps (GOTOs), leading to poorly-structured programs. FORTH is incapable of providing unconditional jumps, which must be a good thing, but does give the conditional IF . . . THEN . . . ELSE structure and three kinds of loop. Together, they make it an excellent language for writing structured software.

Two of the loop structures are conditional, and we will study them in next month's article. Like the IF structure, they rely on the use of conditional operators such as those we have just looked at.

Conditional Branching Structures: BASIC programmers will know the language's

```
IF <condition> THEN <operation 1>
ELSE <operation 2>
```

Its exact counterpart in FORTH is:

```
<condition> IF <operation 1> ELSE
<operation 2> THEN <continue>
```

You can see that this has the usual back-to-front sequence imposed by RPN.

The TOS is initially set to TRUE/FALSE by <condition>. If TRUE, then <operation1> is performed, but if the test gave FALSE, then <operation2> happens. "THEN" defines the end of the conditional sequence and, no matter what the result of the test, the program always resumes at <continue>. As in most languages, the 'ELSE <operation2>' part is optional.

An important point about this structure is that, like all FORTH

STACK	5	6 5	7 6 5	8 7 6 5	1 6 5
	5	6	7	8	<

Fig. 5. The 'greater than' operator . . .

STACK	5	6 5	7 6 5	8 7 6 5	0 6 5
	5	6	7	8	>

Fig. 6. . . . and the 'less than' alternative, with respect to the TOS.

STACK	5	6 5	7 6 5	8 7 6 5	0 6 5	1 6 5
	5	6	7	8	=	0=
					[< >]	

Fig. 7. In true comparative form you can also test for inequality between TOS and 2OS.

STACK	24000	24000 24000	50 24000	1 50 24000	51 24000	51 51 24000	51 24000	24000 51	
	SCORE	DUP	@	1	+	DUP		SWAP	!

Fig. 3. Variable recovery, processing and storage all in one.

STACK	X	X X	ADD A X X	A X X	AX X	ADD B AX X	B AX X	AX+B X	AX + BX	ADD C AX + BX	C AX + BX	AX +BX + C
	X	DUP	A	@	*	B	@	+	*	C	@	+

Fig. 4. Quadratic evaluation on the stack.

looping and branching structures, it can only be used in a colon definition. IF, THEN and ELSE are defining words which must be compiled before they can be used; if you try to use them in the immediate mode, you will get an error message. Obviously, once you have defined a word using them, it can be used immediately.

As an example, let's define "10PRINT" to be a word that prints only numbers that are divisible by 10; if they are not, they are multiplied by 10 and then printed:

```
: 1ØPRINT  DUP DUP 1Ø / 1Ø * = IF .
ELSE 1Ø * . THEN ;
```

The block of code before the IF sets up the condition, while preserving a copy of the original number — it relies for its action on FORTH's integer arithmetic.

Having defined the word, we can use it:

```
18720  1ØPRINT   1872Ø OK
537 1ØPRINT   537Ø OK
```

There are neater ways to define '10PRINT' — how would you improve the definition?

Finite Loops: There are few programs which do not contain a function that has to be repeated a defined number of times. In BASIC we use

```
100  FOR I=1 TO 10 STEP 1
 :
200  NEXT I
```

The equivalent FORTH construct is:

```
<upper limit> <start point> DO
<operation> LOOP <continue>
```

This uses an index, originally set to <start-point>, and increments it by 1 on each loop until it is equal to <upper-limit>, when it stops and picks up the program at <continue>. On each pass through the loop it performs <operation>, which will be executed at least once but will not occur on the iteration in which the index reaches or passes <upper-limit> — it goes up to one less. In this respect it is different from BASIC, so beware!

Inside the loop, it is possible to get a copy of the index by using the word "I". If you are using nested loops, "J" will return the index of the loop immediately outside the one in which the word is used. A warning: the "I" and "J" mechanisms only work if the words are used on the same 'level' as the DO . . . LOOP. If you are defining extra words to satisfy <operation>, they should not use "I" or "J". Get the index into the stack before you use the extra words.

Although DO . . . LOOP must be used in a colon definition, <upper-limit> and <start-point> can be set up at any time — they are simply the top two items on the stack when DO executes.

For an example, let's define the word SQUAREPRINT which will print the numbers from 1 to any given value, and their squares, one pair to a line:

```
: SQUAREPRINT  1 + 1 CR DO I I I . *
. CR LOOP ;
```

Conclusion

Next month, we will really get into the construction of programs, with a closer look at how they are actually put together, and the best way of exploiting the features of the language. We will also see the two conditional loops that FORTH provides, and look in more detail at the significance of the fact that all FORTH systems use two stacks.

POWERS

Frank C Wales

Check the relationship of two numbers on your HP41C

Ever wanted to find out if one number was a power of another? This problem confronted me the other day and, since I had nothing better to do, I decided to see if I could write a program to solve for any number, testing for any root, on my HP41C. The program requires very little space in the machine, runs quite fast, and will test any input number to see if it is the power of any other number. All real numbers are accommodated, and the program notifies you of the signs, both of the number which the first number is the power of, and the sign of the power itself. If the first number is not a power of the second, then an appropriate error message is generated. The program requires four registers, and as the listing is pretty much self-explanatory, I haven't flowcharted it.

Program Running

Operating procedure is quite straightforward: enter the program, press XEQ"POWERS", and the display will show: ROOT?. It wants to know which root you wish to test for (the number is entered as a positive real; both positive and negative roots are tested for). Then press R/S, and the display will then show: POWER?. You now enter the number that you wish to test, to see if it is a power of the root previously entered, then press R/S. The program then performs the tests, and display the appropriate result.

Some examples:

ROOT = 2; POWER = 32,768: 32768 IS 2 ↑ 15
ROOT = 2; POWER = 0.125 : 1.2500E − 1 IS 2 ↑ −3
ROOT = 3; POWER = −81: −81 IS NOT A POWER OF 3 (It isn't)
ROOT = 0; SORRY, BUT NOTHING IS A POWER OF ZERO
ROOT = 5; POWER = 6103515625: 6103515625 IS +/−5 ↑ 14

Program Listing

```
LBL"POWERS"
CF 00
CF 01
CF 29
FIX 0
"ROOT?"
PROMPT
X=0?
GTO 01
ABS
STO 00
"POWER?"
PROMPT
STO 01
X=0?
GTO 02
X < 0?
SF 01
ABS
1
X <> Y
X < Y?
SF 00
X < Y?
1/X
STO 02
CLX
STO 03
LBL 00
RCL 02
1
X=Y?
GTO 03
X > Y?
GTO 02
ST+ 03
X <> Y
RCL 00
/
STO 02
GTO 00
LBL 01
"SORRY,_BUT_NOTH"
"&ING"
TONE 3
AVIEW
"IS_A_POWER_OF_Z"
"&ERO"
TONE 5
PROMPT
LBL 02
CLA
ARCL 01
"&_IS_NOT_A_POWE"
"&R"
TONE 2
AVIEW
"OF_"
ARCL 00
TONE 0
PROMPT
LBL 03
CLA
FS? 00
SCI 4
ARCL 01
FIX 0
"&_IS_"
RCL 03
2
MOD
X≠ 0?
GTO 10
FS?C 01
GTO 02
"&+/-"
GTO 05
LBL 10
RCL 00
FS?C 01
CHS
STO 00
LBL 05
ARCL 00
"&↑"
RCL 03
FS?C 00
CHS
ARCL X
TONE 9
PROMPT
END
```

NOTE: The '_' symbol represents a space, '&' represents Append symbol

THE ENIGMA

D G Burford

Quick coding routines for the ZX81

The following program turns a ZX80 into an Enigma style coding machine, as was used in World War II. A five-letter keyword is entered first, followed by the message to be encoded/ decoded. If '1' is then entered the message will be encoded into four-letter and then five-letter blocks. Entering '2' will decode any message that was coded with the current keyword.

Program Listing

```
10  REM** ENIGMA
20  PRINT "KEYWORD (5)"
30  DIM A(4)
40  INPUT K$
50  CLS
60  FOR J=0 TO 4
70  LET A (J)=CODE (K$)-37
80  LET K$=TL$ (K$)
90  NEXT J
100 PRINT "MESSAGE"
110 INPUT M$
120 CLS
130 GOSUB 420
140 DIM B(N)
150 FOR J=0 TO N-1
160 LET B(J)=CODE(M$)-37
170 LET M$=TL$(M$)
180 NEXT J
190 PRINT "(1) ENCODE (2) DECODE"
200 INPUT C
210 PRINT
220 IF C=2 THEN GOTO 330
230 LET X=0
240 FOR J=0 TO N-1
250 LET B(J)=B(J)+A(X)
260 IF B(J) > 26 THEN LET B(J)=B(J)-26
270 LET X=X+1
280 IF X=5 THEN PRINT " [SPC]";
290 IF X > 4 THEN LET X=0
300 PRINT CHR$(B(J)+37);
310 NEXT J
320 GOTO 200
330 LET X=0
340 FOR J=0 TO N-1
350 LET B(J)=B(J)-A(X)
360 IF B(J) < 1 THEN LET B(J)=B(J)+26
370 LET X=X+1
380 IF X > 4 THEN LET X=0
390 PRINT CHR$B(J)+37);
400 NEXT J
410 GOTO 200
420 LET Z$=M$
430 FOR N=0 TO 1000
440 IF Z$=" " THEN RETURN
450 LET Z$=TL$(Z$)
460 NEXT N
```

AUTO NUMBER

Make keying in your BASIC programs easier by adding this useful utility

Malcolm Holt

Typing in long BASIC programs is a tedious business so any aid which makes this easier is welcome. This short program gives the NASCOM an Auto Line Numbering facility similar to that found in many of the 'Toolkit' types of utility package.

The machine code should be entered from 0CF8 Hex and the BASIC then 'Cold Started'. Return to the monitor and execute at 0D00 Hex which 'Warm' starts the BASIC again. The Auto facility can be turned on and off by entering Control K and the line and interval counters, both initially set to 10, can be adjusted by:

DOKE 3320, X	sets line number to X
DOKE 3322, Y	sets the interval to Y

Whenever NAS-SYS or BASIC want a character from the keyboard the Blink routine is called. This program sets up a new subroutine table at 0C80 Hex and diverts the call to a new Blink routine. The effect is to generate a new line number in the HL register pair and call a routine to print this onto the screen each time a Carriage Return is typed.

Program Listing

```
0CF8 0A 00          LNVAL  DEFW 10        CURRENT LINE
0CFA 0A 00          INCVAL DEFW 10        INCREMENT
0CFC 00             FLAG   DEFB 0
0CFD 00 00 00              DEFB 0,0,0

            FIRST SET UP NEW ROUTINE TABLE

0D00 21 88 07              LD HL,0788     OLD START
0D03 11 80 0C              LD DE,0C80     NEW START
0D06 01 78 00              LD BC,0800-0788
0D09 ED B0                 LDIR           MOVE DATA
0D0B 21 FE 0B              LD HL,0C80-82
0D0E 22 71 0C              LD (0C71),HL POINTER
0D11 2A F4 0C              LD HL,(0CF4) OLD BLINK
0D14 22 8A 0C              LD (0C8A),HL
0D17 21 1F 0D              LD HL,NEW      NEW BLINK
0D1A 22 F4 0C              LD (0CF4),HL
0D1D DF 5A                 SCAL "Z        WARM START

          FROM NOW ON NASCOM WILL COME HERE
          TO OBTAIN A CHARACTER FROM THE KBD

0D1F 3A FC 0C       NEW    LD A,(FLAG)
0D22 CB 47                 BIT 0,A        WAS IT CR?
0D24 28 19                 JR Z,SKIP1
0D26 2A F8 0C              LD HL,(LNVAL)
0D29 ED 5B FA 0C           LD DE,(INCVAL)
0D2D 19                    ADD HL,DE
0D2E 22 F8 0C              LD (INVAL),HL
0D31 2A F8 0C       LN     LD HL,(LNVAL)
0D34 CD AD F9              CALL F9AD      IN BASIC TO
0D37 3E 02                 LD A,2         OUTPUT HL
0D39 32 FC 0C              LD (FLAG),A
0D3C 3E 20                 LD A,20
0D3E F7                    RST 30
0D3F DF 46          SKIP1  SCAL "F        GET CHAR
0D41 FE 0D                 CP 0D
0D43 20 12                 JR NZ SKIP3
0D45 3A FC 0C              LD A,(FLAG)
0D48 CB 4F                 BIT 1,A
0D4A 28 08                 JR Z SKIP2
0D4C 3A FC 0C              LD A,(FLAG)
0D4F CB C7                 SET 0,A
0D51 32 FC 0C              LD (FLAG),A
0D54 3E 0D          SKIP2  LD A,0D
0D56 C9                    RET
0D57 FE 0B          SKIP3  CP 0B          CNTRL K?
0D59 C0                    RET NZ
0D5A 3A FC 0C              LD A,(FLAG)
0D5D EE 02                 XOR 2
0D5F 32 FC 0C              LD (FLAG),A
0D62 CB 4F                 BIT 1,A
0D64 20 CB                 JR NZ LN
0D66 3E 1B                 LD A,1B
0D68 C9                    RET
```

Make the most of your Sinclair ZX Computer...

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Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.

Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status–digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

TEMP – Volumes, temperatures – and their combinations.

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LEFT BLANK

Dear Sir,
May I, through the columns of your letters page, express my appreciation of the service provided by Tangerine Computer Systems of Ely.

A damaged board, quite possibly the result of my own activities, was sent back to them on a Monday. It returned on the Thursday of the following week, the fault repaired, complete with an explanatory note.

The charge for this quick and efficient service was nothing at all, not even postage and packing.

Yours faithfully,
Andrew Zuntz
Cheshire.

Dear Sir,
The details of our computer club now need updating and I would be grateful if you could publicise these changes through your columns.

The Grampian Amateur Computer Society now holds its meetings on the second Monday of the month in the club premises at 35 Thistle Lane, Aberdeen.

Further information on our activities can be obtained from me at the address below or by telephoning 0224-33102.

Yours faithfully,
Alan Hird
20 Harcourt Road
Aberdeen AB2 4NZ.

Dear Sir,
The graphics commands of the Acorn ATOM can cause slight 'snow' if they are not executed during the flyback period. The manual suggests using a wait statement before using a graphics command but I have found that this only works for short lines.

As an alternative I have offered the following short machine code routine into the relevant plotting routine. It does slow the operation down noticeably but eliminates all the snow.

```
20 P.$21;P=544; [
 30 BIT#B002;BMI 544;JMP(540)
 40 ];P.$6
```

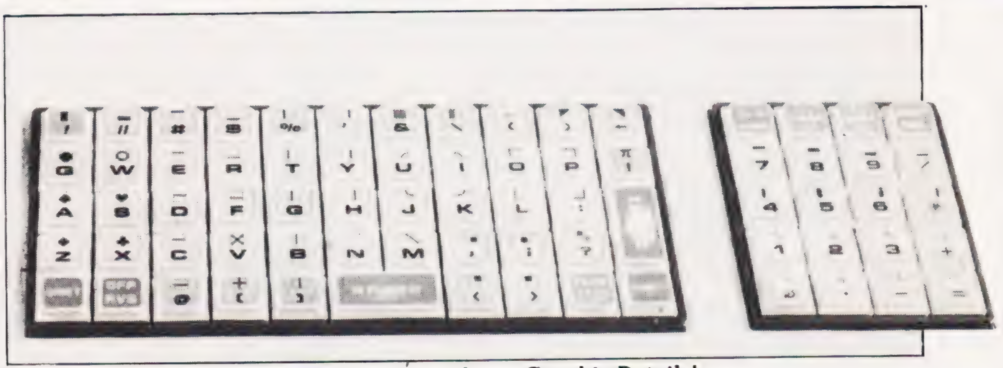
```
100 CLEAR N
110 !540=!#3FE;!#3FE=544
```

The $21 turns off all output to the screen, this suppresses the assembly listing and the $6 turns it back on again.

Bit 7 of Port C (#B002) is set at 0 during the flyback period.

!#3FE is the address of the point plotting routine, set by the CLEAR command and the program resides in locations 540 to 575, an unused part of block zero.

Yours faithfully,
James Allwright
Dorset.



You can see the problems we're having with our Graphic Details!

Dear Sir,
With reference to my program PELMANISM which you published in the December 81 issue, I have just noticed that all the $ signs are missing from the film listing (although the paper listing I used to type the program back into my machine to check it was correct).

The following lines require corrections.

1280 STR$
2000 & 2030 N$
4050 to 4070 A$
5100 N$
5110 C$ and
5160 C$ = STR$

Also, strictly speaking, line 1140 should be IF T>50 THEN T=50 although it works on the Triton.

I apologise to readers who may have had problems with this program.

Yours faithfully,
D M Scales
Kent.

(*So much for the argument about using programs directly as supplied! In fairness though, we should have spotted this too. Ed.*)

Dear Sir,
I was interested to see that you are repeating the Graphic Details series. The information can be very useful for converting programs to run on machines other than those for which they were written. Useful, that is, if one has a listing showing the original graphics characters. However, since your introduction of Standard CT Codes the program listings do not show the actual characters. Unless one has access to the appropriate machine translation of the codes to graphics seems impossible. For example, I do not know what graphics character is represented by shifted E on the PET. It would be very helpful if you could supplement the present series with some conversion tables showing the relationship between CT Codes and the actual graphics symbols.

Yours faithfully,
J J Bexon
Kent.

(*This is a case of chicken and egg, unfortunately. You are quite correct, now we have standard codes it becomes difficult to convert back on to another machine unless you know the trick. Take the PET as an example. The standard character set, on the POKE code table, runs from 0 to 63 — the first two columns. If we add 64 to the value of the alphanumeric character of which we wish to see the Shifted graphic and POKE that; lo and behold, there's the graphic. If we add 128 to the alphanumeric character we get the POKE code for the reversed character, add 192 and we get the reversed graphic. The same holds true for the Sharp MZ-80K with the exception that its reversed character set is replaced by a lower case alphanumeric set. So, to find your graphic, just add 64 (or the appropriate number for your system) and there it is. Simple really, I just forgot to mention it! Ed.*)

Dear Sir,
Please spare a thought for those of your readers whose micros do not support PEEK and POKE. Our data logger uses Solartron BASIC (BASAC) which has no PEEK or POKE command although it does allow you to position the cursor at any point on the 80 by 24 screen. I have many programs which I wish to translate on to this system but cannot, as I do not know where to put the characters on the screen.

What is needed is a detailed explanation of the method of addressing each picture element of the memory map for all popular micros; together with an appeal for people submitting programs to include flowcharts wherever possible.

How about it then?

Yours faithfully,
Charles Finn
Yorkshire.

(*Well, we have hopefully solved the first part of your problem with the Graphic Details that include the screen maps; there are several more in this issue too. As for your second plea I can only say that I thoroughly agree. Please, when you send in a program for publication do try to include at least a functional flowchart. Ed.*)

PRINTOUT

Dear Sir,
I wonder if I could use your columns to try to make contact with three groups of people in the computer field: Editors of user group and other more specialist newsletters, small publishers and bookshops.

It has become apparent to microcomputer users that hardware is not enough and that the key to successful use of computers is software. At least one-half of available software is in the form of printed program listings and these are, in many ways, more accessible to the computer user than machine-readable forms such as tape or disc.

In order to facilitate the use of existing and available software (so that the wheel need not be continuously re-invented), we are publishing the **Small Computer Program Index**. *This is a service to computer users which references each year some 2000 programs which have been published in all types of periodicals and magazines, as well as in books on programming and books of program listings. All application areas are included in these programs, including education, business, science, engineering, games and subroutines.*

We are anxious to expand our coverage of periodicals and newsletters and would ask all Editors to make contact with us so that their publication may be included. In addition we include, in each issue, a list of bookshops and are, again, hoping to expand that list.

I can be contacted at 21 Beechcroft Road, Bushey, Herts WD2 2JU (Tel: Watford 30150 after 7.00 pm).

Yours sincerely,
Alan Pritchard
(Editor, **Small Computer Program Index***)*

Dear Sir,
The following program may be of interest to readers who own an Acorn ATOM which has the Word Pack ROM fitted. It allows alphanumeric characters, with lower case and control codes, to be mixed with the Mode 4 High-Res graphics using PRINT statements.

```
LDY @3
LDX @#60
JSR #ACDE
RTS
```

This can be stored as follows:

```
!#80=#60A203A0;!#84=#60ACDE20
```

and executed by:

```
LINK#80;CLEAR 4
```

Once the program has been run, the display will stay in Mode 4 until BREAK is pressed.

Yours faithfully,
D P Hewison
Yorkshire.

Recommended reading for PET programmers!

Dear Sir,
Congratulations on your series of articles (March-August 1981) by A P Stephenson on machine code programming on the 6502 — easily the most lucid account for beginners I have seen. I have implemented the micro-assembler described in the last article on my PET and used it to good advantage in developing games which required fast moving graphics.

I am currently trying to improve the speed of a BASIC program, which contains an often repeated iterative loop. For this purpose I am trying to manipulate floating point numbers in machine code. Using the micro-assembler, I have worked out how to load floating point variables into the two accumulators and to multiply or divide them using routines from BASIC, but I cannot get the addition and subtraction routines to work in the same way.

None of the books on 6502 programming seem to cover these aspects and I should be pleased if you could give me any hints on how to approach this problem, or let me know any suitable reference.

Yours faithfully,
C Page
Cambridgeshire.

(*The BASIC addition and subtraction routines should be as easily accessible as the multiply and divide. They reside at D76E and D733 Hex respectively — according to 'The PET Revealed'. I can't see why you should have any problems with this method, it is the simplest and most sensible way to get the task done quickly. My only suggestion is that you disassemble the code in this area and have a look at it — maybe you are trying to add in the wrong mode, the SED flag can be checked for this. Ed*)

Dear Sir,
I have just bought the November issue of COMPUTING TODAY. Perhaps you would be interested in my reaction.

Most of it seems addressed to people well into the technology and is incomprehensible to me; there is one article for absolute beginners. I am in between. I know what a bit or a RAM is and the general idea of programming. I am lost when I read such terms as: Pixel graphics, FDC card, port probe, hexadecimal scratchpad, Kenilworth case, DOS, chunky graphics . . .

Personally I am not interested in the technology, but I do want to know whether the image is clear and non-flickering, how long the printer takes to print out a given large number of words, whether the addressing system will recover entries conforming to 2, 3. . . criteria (All As which are also Bs and Cs . . .) I do not see any information of this kind.

Perhaps I am reading the wrong magazine? If so, what do you recommend?

Yours faithfully,
G R R Taylor
Bath.

(*In all seriousness Mr Taylor, I hope you have filled in your survey and sent it back because it is people like you that I'm trying to serve better. The main problem in the market at the moment is simply that you *have* to understand the technology to select the good from the bad. We do try to explain it in simple terms but, if we make it too simple then we are no longer talking to the people we set off writing the articles for — Catch 22! Ed.*)

Dear Sir,
Could I, through your PRINTOUT column, ask if any Commodore user has converted the CUBIK routine featured in the August 81 edition of your magazine for the Commodore range.

I would be interested in obtaining a version for a New ROM PET.

Thank you.
Yours faithfully,
K R Marshall
P O Box 3036
Napier
New Zealand

Dear Editor,
You say in December 'Reverse Polish' is called because of the unprononcablity by English of the name of the inventor the Polish logician.

What complete awkwardness you award us, Editor! Just saying 'LOOKA — SHAY — VITCH' my friend, and you are already nearly Polish, this time!

Valao Valbo
Gloucestershire.

(!!/?*. Ed.*)

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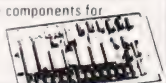

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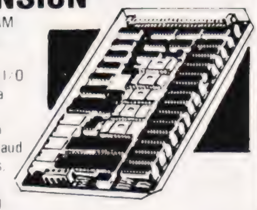

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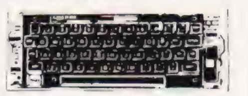

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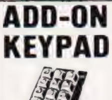

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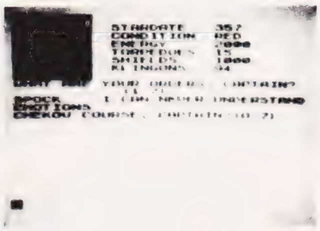

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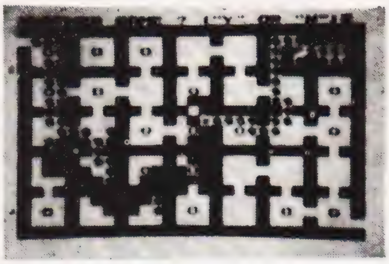

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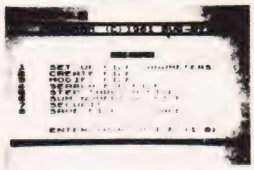

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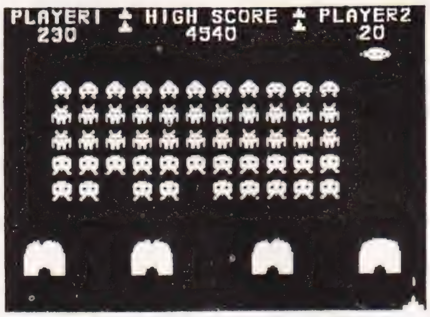

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Peter Freebrey

If you've mastered the techniques of PRINTing the INPUT then now's the time to RESTORE your interest by READing DATA!

As we progress through this series, a number of newcomers to the gentle art of programming will be reading and trying some of the programming examples. BASIC, in its many forms, is the computer language most commonly used by today's microcomputers and can be likened in more than one respect to a living language. One important likeness must be remembered, that being dialect. The English language has a number of dialects dependant mainly upon regional groupings. It is quite possible for people from different parts of the country to have great difficulty in understanding one another. Not only does the sound vary but also the constructions of the sentences, not to mention words that have a meaning unique to certain regions. BASIC has a number of dialects that vary to a greater or lesser extent depending upon the make of computer. These variations fall into several categories:

1) words used for a statement or command performing the same operation,
2) the number of statements allowed per program line,
3) the punctuation required for a given operation,
4) the permitted variable names.

Although the differences are not usually very great they can cause some confusion, especially if the newcomer is not yet familiar with his machine's version of BASIC. It is not always possible for this series to cover all dialect variations, so if one of the example programs does not work . . . 1) check that you have typed it in correctly, 2) check to see if your manual shows a different way of achieving a similar result, 3) blame the Editor or the printers for a typographical error, 4) blame me and write and tell me about it!

Variations On A Program

Some examples of the above variations that might have been met so far are:

1) PRINT and INPUT are fairly common but you can find PRT and INP
2) many machines allow multiple statements on one program line.

```
eg 10 FOR K = 1 TO 10: PRINT K :NEXT K
```

some allow only one

```
eg 10 FOR K = 1 TO 10
   20 PRINT K
   30 NEXT K
```

3) the punctuation acceptable to different machines can be somewhat frustrating, the most common variance being the use of commas and semi-colons together with the use or not of blank spaces.
4) the variable names acceptable to your computer must be checked against your manual, single letters of the alphabet are acceptable to all computers as numeric or string variables (with the addition of $), not all will accept AA, B3 etc. If your computer will accept more than one character variables you must be careful not to use a combination that forms one of the BASIC instruction words, for example TT = 33 is acceptable but TO = 33 is not (TO is a BASIC word . . . FOR-TO-NEXT).

The Data You Need

Last month we dealt with the BASIC instruction FOR . . . NEXT which gave us a program that would loop back on itself and repeat a portion of the program a defined number of times. This month we will look at the instructions READ and DATA. Up to this point if we had wished to assign a value (numeric or string) to a variable we would have had to use INPUT. Using READ and DATA, values may now be assigned to variables from information held *within* the program. They are used either when large numbers of variables are to be assigned or if an entry is to be hidden from the operator (as in a game or teaching exercise).

The READ statement assigns a value predetermined by the program to a specific variable. The DATA statement contains the pool of values from which the READ statement can derive its variable values. Both statements may contain a list of variables (READ) or values (DATA) separated by commas, for example:

```
10 READ A,B
20 PRINT A
30 PRINT B
40 DATA 50,6,17,65
50 END
```

If this program is RUN the values 50 and 6 will appear displayed on the screen. Note that the DATA statement may have more variables than required by the READ statement but *never* less. The variables called by READ may be numeric or string but must be matched by appropriate DATA numerics or strings:

```
10 READ A,A$,B,B$,C,X$
20 PRINT "A ";A$;" HAS ";A;" LEGS"
30 PRINT "A ";X$;" HAS ";C;" LEGS"
40 DATA 2,CROW,2,MAN,4,HORSE
50 END
```

Where To Keep It

DATA statements may be written into a program at any point but are normally written as a DATA block at the end of the program. The following two programs will give exactly the same results but the second gives the preferred format:

```
10 DATA MAN,1
20 READ A$,A,B$,B,C$,C
30 PRINT C,C$
40 PRINT B,B$
50 DATA MEN,2
60 PRINT A,A$
70 DATA MEN,3
80 END
```

```
10 READ A$,A,B$,B,C$,C
20 PRINT C,C$
30 PRINT B,B$
40 PRINT A,A$
50 DATA MAN,1,MEN,2
60 DATA MEN,3
70 END
```

The rules for READ and DATA statements are as follows:

1) variables (READ) and values (DATA) must be separated by a comma with *no* comma after the last item,
2) there must be at least as many (or more) DATA values as there are variables in the READ statements. Extra DATA will be ignored but less will result in an error message and the program may terminate,
3) DATA values must match in type (numeric or string) the order in which the variables are called by READ statements,
4) DATA statements must only be numeric or string. Variables or functions are not acceptable,
5) strings having leading or trailing blank spaces or containing punctuation marks (,;:) must be enclosed in quotation marks (" ").

READ and DATA allow a RUNning program to access information in a predetermined (sequential) order from the program itself. When used in conjunction with a FOR . . .NEXT loop this enables variables to be assigned different values in a known sequence. Consider the following program which will display the distance between any two specified points on a bus route (!).

```
10  Z = 0
20  INPUT "FIRST POINT ";X
30  INPUT "SECOND POINT ";Y
40  FOR K = 1 TO X
50  READ A
60  NEXT K
70  FOR J = 1 TO (Y-X)
80  READ A
90  Z = Z+A
100 NEXT J
110 PRINT Z;" MILES"
140 DATA 0,0.2,0.3,0.5,1.6,1.1,0.2
150 DATA 0.3,1.1,0.6,...........etc
160 END
```

Line 140 lists the distance between each bus stop as the DATA statement. The first FOR . . .NEXT loop, lines 40-60, READs the distance between each stop up to the specified Xth stop. This information is then ignored, it is simply to get the program to the right starting point for the next operation. The second FOR . . .NEXT loop READs the distance between stops for the specified number of stopping points (Y-X) and adds each distance to the current total at line 90. The result of this total is displayed when the program reaches line 100.

If you wish to use this program repetitively you will have to RUN the program each time. As most computer operators are of a lazy disposition, perhaps we should explain a way round this. It requires the use of two additional BASIC commands; GOTO and RESTORE. These are inserted in the program as lines:

```
120 RESTORE
130 GOTO 10
```

RESTORE instructs the computer to reset the DATA pointer to the first DATA element. Without this instruction the READ statements in lines 50 and 80 would continue READing the DATA elements in sequence. The distances would be in the wrong order and, eventually, there would not be enough DATA, so resulting in an OUT OF DATA error message.

GOTO 10 in line 130 simply instructs the program to jump to line 10 and continue executing the program from that line. This means that the program is now one large loop and to exit from the program you will have to break that loop. This may be achieved by keying RETURN when the program requests FIRST POINT?

With this program it is possible to get incorrect results! Simply enter the first point as a greater number than the second point. This sort of error can be guarded against with careful programming and your own programs should always be written on the assumption that an absolute idiot will RUN them. Completely 'crashproofing' a program can be quite a task but eliminating the elementary nasties is simply common sense.

Next month we will be dealing with IF . . .THEN statements, a major addition to your programming armoury as they allow you to program the computer to make decisions. These decisions, amongst other things, may be used as the basis of elementary 'crashproofing'.

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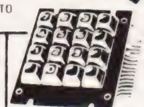

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BOOK PAGE

S M Gee

Just three books come under our scrutiny this month but they are all on a common subject; the microchip and its impact on society.

There are aspects of computing which affect all of us whether we are interested in computers or not. Our daily lives are already governed in all sorts of ways by the ubiquitous chip — from the small devices in traffic light sequencers to the vast machines which cope with the registration of all the vehicles on the road. Even if you are a dedicated enthusiast you may well have never paused to consider the development of computer technology — how often have you heard someone say (or even said yourself) that you don't need to know the first thing about what goes on inside the computer in order to use one? In some ways this is a very attractive aspect of computing as a hobby — it means that you can skip all the 'unnecessary preliminaries' and get right down to whatever you want to do with your machine. However, as computers play an increasingly large part in our day-to-day lives there is perhaps a case for pausing to consider their development, the impact of their technology here and now, as well as their implications for the future.

The three books I've been reading this month all tackle with these issues in one way or another. All are designed to be 'educational' and all of them pose questions which all of us will find relevant. They are, in other words, contributions to the current debate about the place of the chip in our society.

Introducing Computers is one of the Macdonald 'Guidelines' series. It is quite a departure from other titles in the series — topics like photography and embroidery being more typical. The author Ron Condon, is well qualified to write this book, having been a computer journalist for the best part of a decade. The book is very attractively produced with colour and black and white illustrations. This book is for the general reader and adopts the simplest approach out of my three choices.

The book "sets out to explain computers and to show that there is really nothing mysterious about them". It outlines the history of computers from their origins in the abacus, through Napier's 'bones' and Babbage's Difference Engine, to the present day. It describes the structure of computers and gives simple descriptions of input and output devices. In a section called 'working with computers', various jobs in data processing are described. The capabilities of computers are examined in sections on computer intelligence and future developments and, in the section about social implications, the issues of privacy, human rights and employment are discussed. Towards the end of the book there is an illustration of how computers impinge on our lives. This takes the form of a scenario — a day in the life of an ordinary man. Two short sections deal with choosing a micro and programming in BASIC and the book concludes with a tiny reference section including booklist, list of organisations and glossary.

The next book is a very different one, included for those of you who are looking for an academic approach to the issue of the place of computer technology in our society. The subtitle of Burn's book, **The Microchip** raises the question 'appropriate or inappropriate technology?', but this does not really reflect his concern, which is more about evaluating the beneficial and adverse effects of microcomputer technology. On balance, he spends more time outlining its bad points — from the exploitation of cheap labour in South East Asia to the dangers of VDUs. Indeed, he appears to find it difficult to be optimistic even when, at the end of his book, he gives 'a few isolated examples of socially beneficial applications.' Although concluding that the microchip is an appropriate technology he obviously feels threatened by its potential misuse.

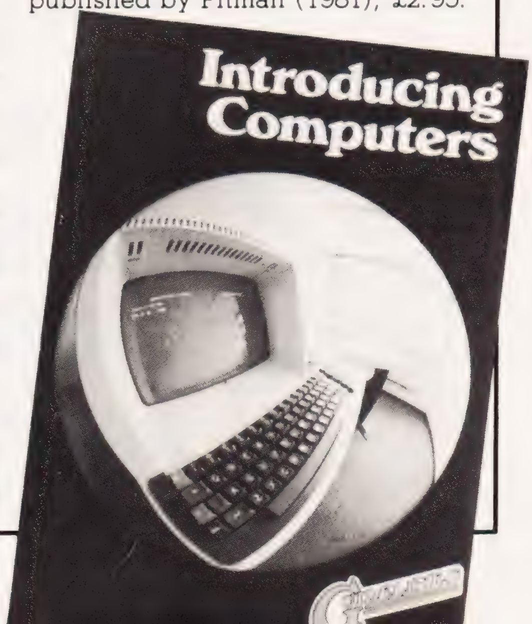
The book is aimed at a wide audience including teachers and students of computer science, technologists, engineers, ecologists and economists. It also reviews the history of the computer and looks at its applications, doing so at length.

This book certainly does not provide answers to all the questions it raises. I consider it a controversial book — but then it deals with a highly controversial subject.

Shelley's **Microfutures** also focusses on the microprocessor — the device which, it must be remembered, is to be found in domestic appliances as mundane as the washing machine as well as in computers. It devotes a chapter to the 'traditional computer' — meaning the mainframe — and another to the microcomputer, which includes dramatic information about the way in which components have become smaller and cheaper with each generation of machines. The heart of the book is the chapter 'How chips are made' This gives a clear and fascinating account of the highly technical processes of silicon chip manufacture. The chapter on 'Using chips' gives a wide variety of applications for the microprocessor, from uses in the motor industry (for example, anti-crash devices) to one in the retail trade. A whole chapter examines 'Microcomputers in schools' while the final chapter explores the issues which will affect us all in the future; privacy, employment, the accessibility of information and its implications for education and biotechnology. After all this, Shelley ends with a quotation from Shakespeare — yes, the Bard of Avon!

The titles included in this month's selection are:

Introducing Computers, by Ron Condon, published by Macdonald Guidelines (1981), £2.50 (softback), £3.95 (hardback).
The Microchip: Appropriate or Inappropriate Technology, by Alan Burns, published by Ellis Horwood (1981), £12.50.
Microfutures, by John Shelley, published by Pitman (1981), £2.95.



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Once again we look at the systems market and include all the new machinery.

The next few pages of the magazine are given over to a comprehensive guide to what's available on the UK computer market. The information is intended to be used as a quick reference to the vital statistics of the various micros, both by people looking to make their first purchase and those seeking to upgrade. The purpose of this 'Guide to the Guide' is to explain how to interpret the information which follows in order to get the most out of it.

From The Top

Each bold type section contains the range of computers manufactured by that company. The actual manufacturer may not be involved in direct selling to the public — Atari for example. In cases like this we give you the name and address of the major UK distributor.

The next important detail is the type of **CPU** that's used in the computer. If your requirements call for a specific CPU this entry is essential. If you are merely interested in high-level language programming then the CPU is probably not so critical.

Remember Remember

The computer's memory capacity is the next item on the list. **RAM** stands for Random Access Memory, the kind you load your programs into as opposed to ROM (Read Only Memory) which is what the manufacturer loads his software into. Generally one figure is quoted and this is the amount that is supplied with the basic machine, 48K for example. If there are two figures, 8K/32K as in the case of the Commodore PET, this indicates the range of memory that's available.

The 'K' stands for 'binary thousand' (1024) so an 8K machine contains 8192 bytes of user memory. Each byte of storage will hold one character; a letter, a number, or a graphic symbol. This may be part of a program or simply information such as a set of names and addresses. Most of the systems in the Guide are based on eight bit microprocessors and these have an addressing capability of 64K — that's 65,536 bytes. Sometimes you may see a figure greater than this in the RAM entry, and in these cases the manufacturer is using a special technique called 'bank selection' to increase the amount of memory that can be supplied, 227K in the case of the NASCOM.

Storage And I/O

When you have produced a computer program which works, you will want to store it away somewhere — it disappears from RAM when you turn the power off. The usual method for personal computers is to use a conventional cassette recorder; special tape is recommended. The **CASS** entry tells you whether this facility exists and to what standard, if known. Typical ones are CUTS, short for Computer Users Tape System, and Kansas City, named after the place where the standard was defined. These convert the digital information inside the computer into a series of tones which can be recorded onto magnetic tape. The speed of storage and retrieval is worth checking, a fast speed such as 1200 or 2400 baud is convenient but inherently less reliable than a slow speed such as 300 baud. The term baud originally came from the telegraphic industry and refers to the number of transitions occurring per second, it is ***not*** the number of bytes that are transferred per second. Ideally your computer should offer a choice of baud rates, 300 and 1200 is a typical example, and this allows you to save a master copy for security and make a second, faster version for day-to-day use.

A more expensive but generally faster and more flexible (no pun intended) method of storing programs is the floppy disc and this is shown in the **DISC** entry. These come in two sizes, 5¼" and 8", and are available in single and double sided and single and double density versions as well as combinations of the two. Obviously you'll be able to fit more onto an 8" disc than a 5¼" disc and these tend to be used in professional and small business systems as they are more suited to heavy usage. For people with a lot of information to store there is another type of disc known as a 'hard disc', shown as Hd in the list. These are capable of holding millions of bytes as opposed to the tens or hundreds of thousands found on the floppy disc. They do, however, carry a large price tag. A typical example of a hard disc based system is the Cromemco Z2H which is fitted with a 10Mb (megabyte) Winchester technology hard disc unit.

Getting the information in and out of the computer to a printer or a Visual Display Unit requires the computer to have input/output capability and this is indicated by **I/O** in the table. There are three major types of I/O and two specials. The most common type is serial, indicated by SER, and this can be RS232, V24 or 20mA depending on the peripheral being used. The second type is parallel, indicated by PARA, which is effectively just an extension of the computer's data bus with some control capability built in — an over-simplification but easier to visualise. The third type that is commonly found is IEEE which is a special sort of parallel interface which allows many different peripherals to share the same connection to the computer. It is normally found in machines that are used in a scientific environment, the PET is a notable exception.

The two specialised forms of I/O are the dedicated printer port, shown as PARA.P, which allows a Centronics type printer to be fitted and the bus which is used for the expansion of the system, SS50 and S100 are typical.

The Soft Edge

If you are intending to program in a high level language (one that uses words rather than the machine code of the CPU) then look at the entries beside **BASIC** and **Other**. The most common language is BASIC although others such as Pascal are rapidly gaining in popularity. The **m/c** entry is also important here because it indicates whether the system will allow you to program it in machine code, the number indicates the amount of ROM that the manufacturer has fitted his monitor into.

An entry such as CP/M in the **m/c** slot shows that the discs are running under control of a Disc Operating System, DOS for short, and this often gives you access to a large quantity of ready-made programs and languages.

The Price You Pay

The figure in the **£** entry is obviously the price of the given system. Although these are checked regularly for their accuracy, the manufacturers do tend to change them at short notice so it is well worth checking.

The **Extras** and **Applications** entries give a brief idea of the support and expansion capabilities of the system and the area in which it is likely to perform best.

When you have compiled a short-list of the systems that seem to meet your needs you should try to get 'hands-on' experience with them. Always make sure that your dealer is a recognised one and, if possible, ensure that he is a member of the Computer Retailer's Association, the CRA.

Over the years Computing Today has **Reviewed** many of the systems listed here and those that we have looked at are indicated. Copies of the reviews are available from our offices, and cost £1 each.

ACT Microcomputers

UPDATE

SIRIUS I
Dist:- ACT Computers, Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT
021-501 2284

CPU	8088
RAM	128K/512K
I/O	2 SER, PARA.P, IEEE
CASS	N/A
BASIC	BASIC-80 (+3 in 1982)
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Apple Computers

UPDATE

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Dist:- Apple Computer (UK) Ltd., Finway Road, Hemel Hempstead, Herts HP2 7PS.
0440-48151

CPU	6502 compatible custom
RAM	128K/256K
I/O	SER, PARA.P, D to A
CASS	N/A
BASIC	Business BASIC
Other	Various
DISC	5¼"
m/c	SOS
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Extras:- ProFile hard disc, Up to four drives, More I/O capability.
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British Micros

UPDATE

MIMI 801
Dist:- British Micros, Penfold Works, Imperial Way, Watford, Herts WD2 4YY.
093-48222

CPU	Z80A
RAM	64K
I/O	2 SER, PARA
CASS	N/A
BASIC	BASIC-80
Other	Various
DISC	2x5¼" DSDD (700K)
m/c	CP/M
£1,350	

Applications:- Serious personal computing, small business and wordprocessing.

Datatrak

UPDATE

QUASAR QDP-100
Dist:- Datatrak, Gayton, Northampton NN7 3EU
0604-858011

CPU	Z80A
RAM	64K
I/O	2 SER, 1 PARA, S100
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x8" DSDD
m/c	CP/M, MP/M
£3,380	

Extras:- 5 Mb Winchester.
Applications:- Software development, DP Front-ending.

Mediatech

UPDATE

EAGLE II
Dist:- Mediatech, Woodside Place, Alperton, Wembley, Middx HA0 1XA
01-903 4372

CPU	Z80A
RAM	64K
I/O	—
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x5¼"
m/c	CP/M

Extras:- Winchester disc.
Applications:- Desktop small business system.

North Star

UPDATE

ADVANTAGE
Dist:- Comart Ltd., P O BOX 2, St Neots, Huntingdon, Cambs PE19 4NY.
0480-215005.
+ many regional dealers.

CPU	Z80A
RAM	64K
I/O	SER
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x5¼"
m/c	CP/M, Graphics DOS
£2,500 upwards	

Extras:- Up to five plug-in option boards.
Applications:- Desktop system complete with business graphics software.

OKI Computers

UPDATE

OKI IF800
Dist:- LSI Computers, Copse Road, St Johns, Woking, Surrey GU21 1SX.
04862-23411.

CPU	Z80A
RAM	64K
I/O	Serial
CASS	N/A
BASIC	BASIC-80
Other	On disc
DISC	2x5¼" DSDD (560K)
m/c	CP/M optional
£4,500 upwards	

Extras:- Serial and parallel interfaces, A to D etc.
Applications:- The system features colour graphics and a built-in 80-column printer. The capability also exists for plugging in a 4K ROM cartridge.

Olympia

UPDATE

BOSS
Dist:- Olympia Business Machines, Olympia House, 199/205 Old Marylebone Road, London NW1 5QS
01-262 6788

CPU	Z80A
RAM	64K
I/O	2 SER, PARA.P
CASS	N/A
BASIC	Business BASIC
Other	Various
DISC	2x5¼"
m/c	CP/M
£3,000 upwards (complete)	

Extras:- Various disc configurations, choice of three printers.
Applications:- Desktop small business computer/wordprocessor.

Onyx

UPDATE

SUNDANCE
Dist:- Keen Computers, Minerva House, Spaniel Row, Nottingham.
0602-412777

CPU	Z80A
RAM	64K
I/O	2 SER, PARA.P
CASS	N/A
BASIC	Various
Other	Various
DISC	6Mb Hd with 12Mb tape back-up
m/c	CP/M, OASIS
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Applications:- The system may be networked for business operations and several software packages are being offered.

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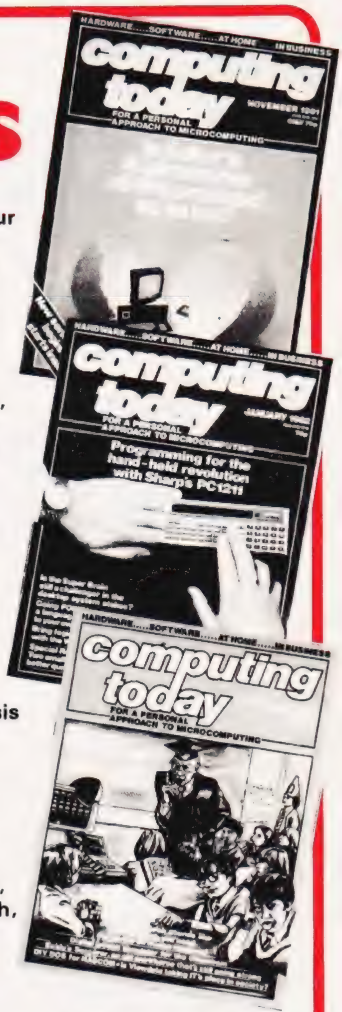

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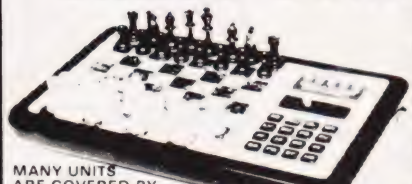

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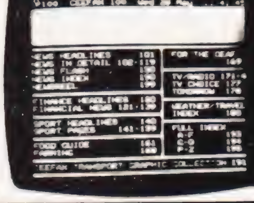

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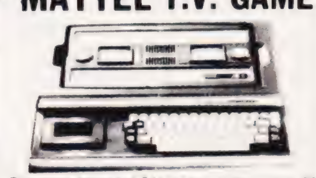

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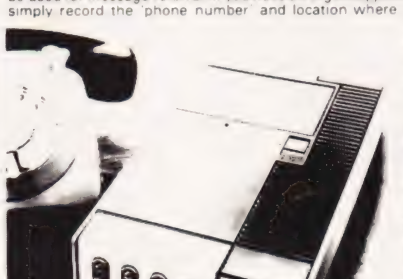

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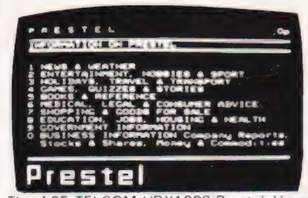

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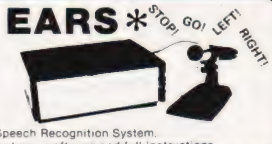

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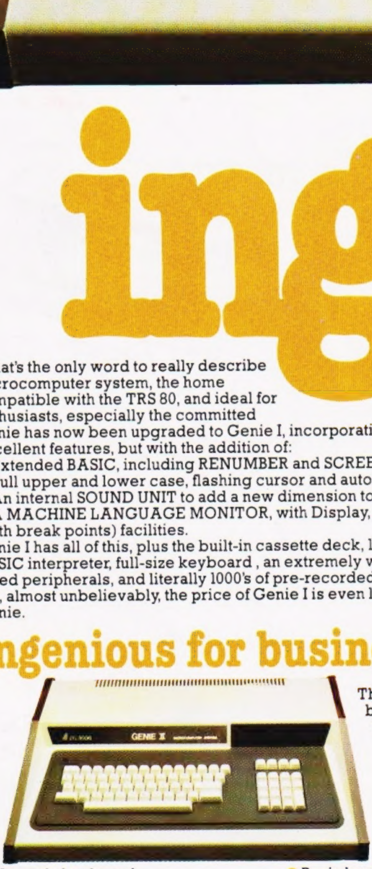

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